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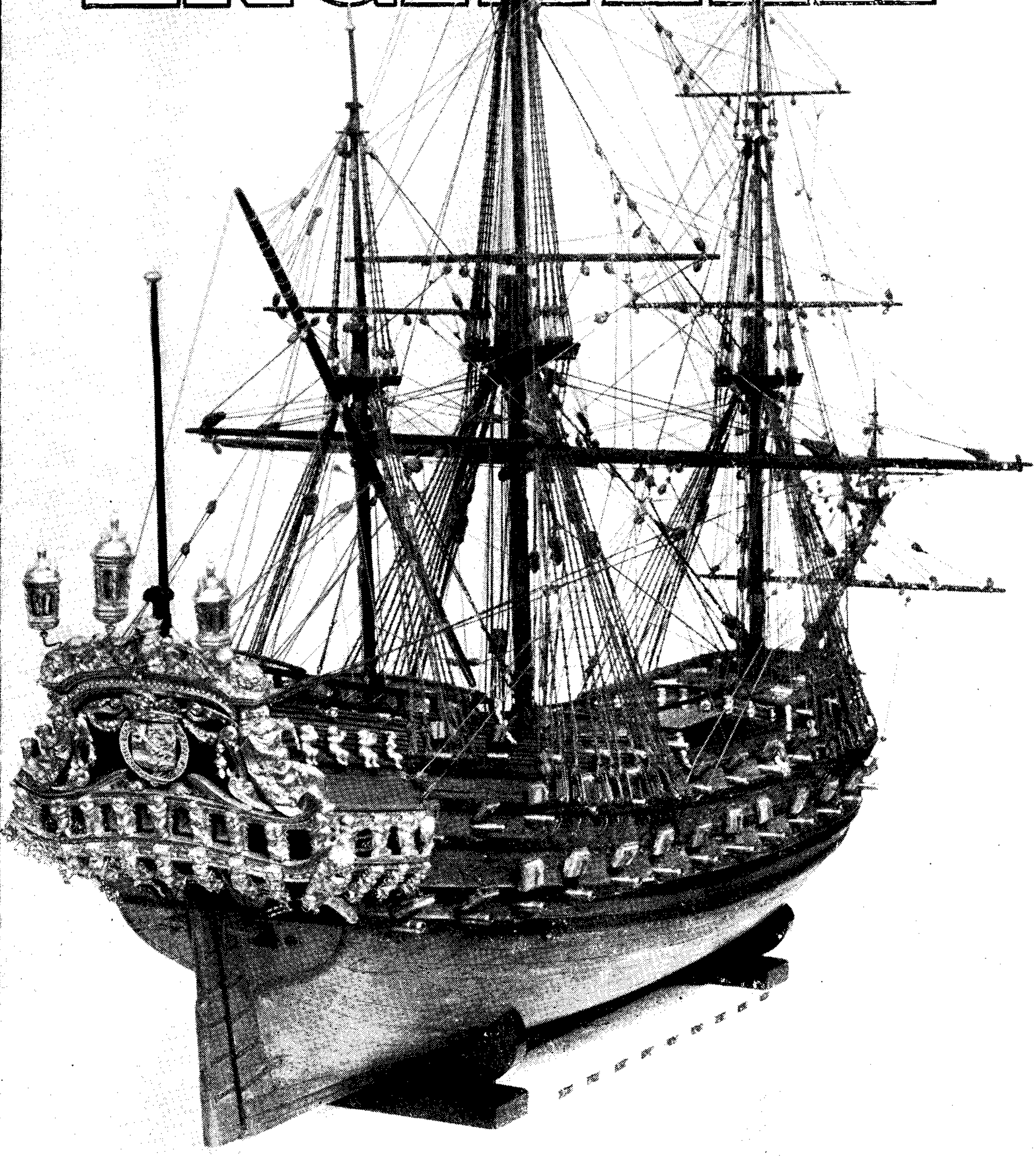
THE MODEL ENGINEER



The MODEL ENGINEER

PERCIVAL MARSHALL & CO. LTD., 23, GREAT QUEEN ST., LONDON, W.C.2

26TH JULY 1951 VOL. 105 NO. 2618

SMOKE RINGS

Our Cover Picture

● THE PHOTOGRAPH we have used this week is a model of a Dutch man-of-war, of 1665, which is in the National Maritime Museum, Greenwich. In the Science Museum, South Kensington we have a model of a British ship, the *Prince*, of 1670, and the two models afford a very interesting comparison. In the Dutch ship, as will be seen from the photograph, the stern has a flat transom, whereas in the British ship the planks were bent upward to form what is known as a round tuck. This was more difficult to build but gave an easier run or flow to the water as the ship passed through it. The decoration of the Dutch stern is much more ornate than that of the British ship, and also the stern is broader and has only one row of windows, whereas the British ship has two. The gun ports on the upper deck of the British ship are surrounded by carved wreaths, whereas in the Dutch ship they are left bare. The spars and rigging are similar in both cases but even here there are small differences by which the expert can detect the nationality of the ship. The model in our picture is a half-size copy of a contemporary model which was presented to Prince William of Orange in 1665 and whose arms are on the stern. The rigging is by Mr. R. C. Anderson, who is the recognised authority on the rigging of that period. The ship is pierced for 76 guns and measures about 154 ft. on the gun deck and 42 ft. beam outside the planking.

Merseyside Exhibition

● WE HAVE received a note from Mr. A. F. Duckett, hon. secretary of the Merseyside Live Steam and Model Engineers, informing us that the exhibition recently held by the society was a great success ; in the six days it was open, there were more than 6,000 visitors. There were 210 models valued at more than £5,000, which indicates that an excellent show had been got together. Mr. Duckett writes : "All to whom I spoke were enthusiastic and wanted to know why it had not been held before. One gentleman suggested that it should be continued for another week, averring that it would be impossible to stage another as good in the future. Little does he know!"

So it is clear that Merseyside put on a fine show which must have done much to uphold the prestige of our hobby, and we have no doubt that the success achieved by this first exhibition will act as an incentive to an even better one next time.

"M.E." Exhibition Prizes

● WE REPRODUCE herewith a photograph of the handsome silver cup which has been given by Sir Frederick Maze, K.C.M.G., K.B.E., to encourage interest and skill in modelling Oriental sailing craft of any period, or sailing ships of the pre-1820 era. It is certainly a trophy worth winning.

We are pleased to announce that Mr. V. B. Ferguson has offered a prize of £2 2s. od. to be awarded to the best model stationary engine of any type. Interest in this particular subject seems to be on the increase at the present time, but at the moment of writing this note, we have no news of any models of this type being entered in the forthcoming "M.E." Exhibition. We hope, of course, that we shall see a few contestants for Mr. Ferguson's prize.

Obituary

● WE VERY much regret to learn of the death of Mrs. Percival Marshall, which occurred suddenly on July 7th. She had been in poor health during the last two years, but was well enough to attend the opening of the "M.E." Exhibition last year.

Mrs. Marshall was known to many of our readers, since she usually accompanied her late husband when he visited any model engineering function at which ladies were present. Although she did not take any active part in model engineering activities, she often astonished some of her more intimate acquaintances by her keen interest in our hobby and especially by her appreciative insight into many of its problems. She was quick to notice any outstanding piece of craftsmanship, and would sometimes give friendly and helpful advice if she thought it was needed.

Until 1948, Mrs. Marshall visited every "M.E." Exhibition, through which she came to know so many of our readers.

We also regret to learn of the death of Mr. G. Geoffrey Smith, Chief Editor and Director of the Associated Iliffe Press Ltd.; he was 66. After an engineering apprenticeship, he joined the editorial staff of *The Motor Cycle* in 1904, and was appointed editor of that journal eight years later.

In the 1914-18 war, Mr. Smith organised the recruitment of 10,000 motor-cycle despatch riders, mobile machine-gunners and armoured-car drivers, for which service he was made an M.B.E. He was later in the Royal Flying Corps, engaged on technical duties concerning aero engines.

After the war, he assumed direction of an increasing number of Iliffe journals. During the second world war, he joined numerous technical and Press committees and advisory panels. In 1944, he was invited by the Government to go to America where he spent nine months in publicising Britain's technical achievements.

After becoming a director of Iliffe & Sons Ltd. in 1923, and afterwards of a number of its subsidiary companies, he was appointed a director of the parent company, Associated Iliffe Press, in 1945. His able control will be much missed by those who follow him.

Wood-turners, Ahoy!

● WHAT PROVED to be a great attraction at last year's "M.E." Exhibition was the wood-turning demonstration by Mr. F. Pain, of High Wycombe, and we are pleased to learn that Mr. Pain and his equipment will be present at this year's show.

One of the most frequent questions put to Mr. Pain, last year, was how long holes were bored in such things as floor standards. An attachment made up for an M.L.8 lathe will demonstrate the process; it is so simple that Keith Biggs, a 12-year-old High Wycombe choirboy who had never seen a lathe at work, was able to set up the attachment in two minutes and, after being shown how it worked, he bored a $\frac{5}{16}$-in. hole dead true through a piece of wood 20 in. long in $4\frac{1}{2}$ minutes.

There is available a limited number of elm discs 3 in. thick and in two diameters, 10 in. and 6 in., respectively; these can be bought at 2s. 6d. and 1s. 6d. each, according to size, and Mr. Pain will turn them into useful bowls, free of charge. These discs can be "booked" beforehand by anyone writing to Mr. Pain at 64, Chairboro Road, High Wycombe, Bucks; but *no* money should be sent with orders. Due to the limited supply, first orders will have priority; but the selected discs will be turned into bowls on the stand at the exhibition, upon the customer presenting himself and paying for the selected disc.

A "pole" or "bodgers" lathe is still in use near High Wycombe; with it a simple chair leg can be turned from wet beech in 40 seconds, the shavings being about 18 in. long and 2 in. wide. Mr. Pain will have some photographs of this interesting old implement, together with some examples of its work, on view.

"Britannia" in $3\frac{1}{2}$-in. Gauge

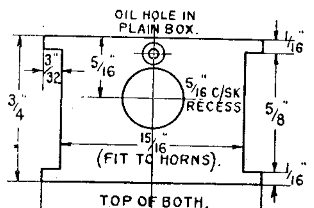
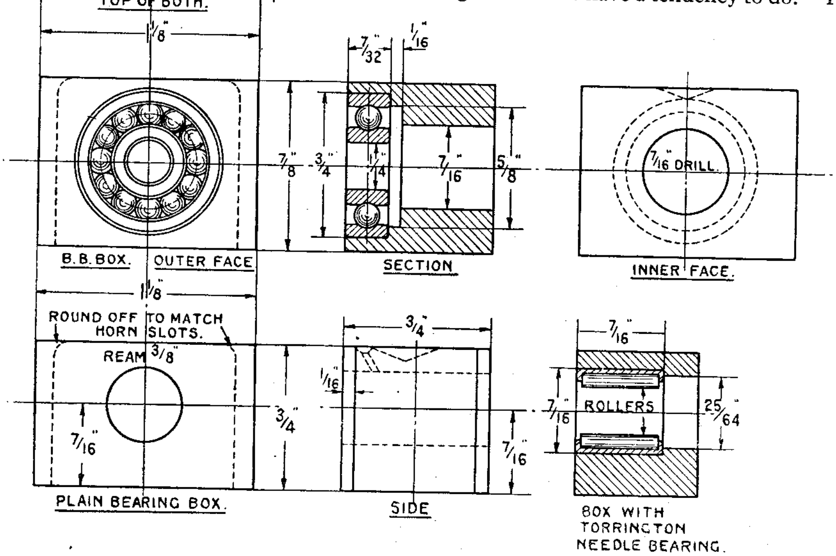
by "L.B.S.C."

THREE kinds of bogie axleboxes are shown for the lion-and-wheel job, having ball, plain, and needle bearings respectively, so there are plenty to choose from! The largest commercial ball-bearings that will fit into a reasonably-sized bogie axlebox on this job, are $\frac{3}{4}$ in. diameter, 7/32 in. wide, with a $\frac{1}{4}$ in. hole, and unfortunately this restricts our journal size to $\frac{1}{4}$ in., with a slightly smaller diameter wheel seat; but that is one of the things that cannot be helped. If larger bogie axleboxes are used, the frame would have to be made bigger also, and that would cattle up the whole works, as a bigger bogie would be difficult to fit to the engine. The axleboxes for all three kinds of bearings are machined in the same way, so we shan't have to repeat a whole lot of ritual—thank goodness, says you.

The best material for the axleboxes would be cast bronze; but if our advertisers are prevented from supplying bronze castings by the bloodshed-and-destruction racket, then whatever material is available, will have to be pressed into service. Cast-iron boxes would be quite satisfactory, both for ball and needle, or plain bearings; the steel axles in the latter case, could run direct in the cast-iron—some lathes have cast-iron bearings—or bronze or whitemetal bushes could be fitted. Ordinary soft brass, or "screw-rod," could be used for all three kinds, but it would be advisable to bush the plain holes with either bronze or whitemetal, as mentioned above. I would not recommend aluminium, but solid whitemetal boxes would do all right at a pinch. Anybody who is lucky enough to get hold of a bit of drawn bronze bar, of $\frac{3}{4}$ in. $\times$ $1\frac{1}{8}$ in. section, would indeed be in the clover; I was rather lucky myself in getting a bit of cast bar, slightly larger in section, which machined up very well.

A "Ditto Repeato" Job

The actual machining of the axleboxes is done in precisely the same manner as described for the main axleboxes. If cast bar is used, whatever metal, true it up on all four sides, so that the wider side is $1\frac{1}{8}$ in. across, and the narrower side $\frac{3}{4}$ in. across. Then, if a regular milling machine isn't available to machine out the grooves, or channels—they are rather wide to be called grooves!—do the job on the lathe. Clamp the bar on its side, under the slide-rest tool holder, and traverse it across a $\frac{5}{8}$-in. endmill, or home-made slot drill, held in the three-jaw. In days gone by, before I had a milling machine, I did my axleboxes thus, and preferred my home-made slot drills to regular endmills; they seemed to cut cleaner and quicker, having only two cutting edges, and didn't tend to choke, which multi-edged endmills have a tendency to do. The piece

Details of bogie axleboxes

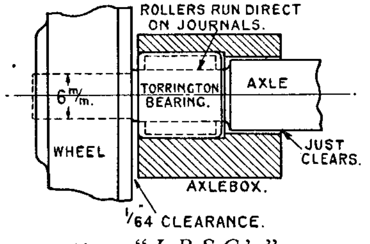
of bar for the axleboxes of my own engine's bogie was machined on my miller; as I hadn't a cutter $\frac{5}{8}$ in. wide, I put two thinner cutters, $\frac{3}{8}$ in. and $\frac{1}{4}$ in., on the arbor side by side, and their combined efforts did the trick in fine style.

My own boxes were parted off to correct length in the four-jaw, but they may be sawn, and faced off to length separately; after which each may be fitted to one of the openings, and marked, same as the main axleboxes. Note the difference in length, viz. $\frac{7}{8}$ in. for ball bearings, and $\frac{3}{4}$ in. for plain bearings, or needle bearings, if same should be available. I don't suppose there will be many of the latter type, made up in this country but if any of our friends in U.S.A. and Canada are building a little *Britannia*, they can use Torrington needle bearings, same as I have used on my own engine. A kind friend sent me over, some time ago, a dozen of them, $\frac{7}{16}$ in. diameter and $\frac{7}{16}$ in. wide, to take a $\frac{1}{4}$ in. journal, and they came in just right for the carrying wheels of the engine; and the six tender boxes, when I have made them, will also have these bearings.

Single Bearings Only

As with the coupled axleboxes, mark off and drill the boxes, one one side of the bogie, and use each as a jig to drill its opposite mate. For the ball bearings, make up a glorified pin-drill, same as illustrated previously, the pin being $\frac{7}{16}$ in. diameter, to fit the $\frac{7}{16}$ in. clearing hole through the axleboxes. Set the cutter to cut a recess $\frac{3}{4}$ in. diameter, a nice push fit for the ball-bearing. One only will be needed for each axlebox, as the bogie wheels have a much easier job than the coupled wheels. The bearing I have shown, is a standard $\frac{3}{4}$ in. single-row, and is 7/32 in. wide, so would need a recess exactly that depth; but if any builder is lucky enough to get hold of some double-row self-aligning bearings, which would be just the cat's whiskers for the job, the depth of the recesses should, of course, be made to suit. When all four bearing recesses have been cut, grind the cutter a wee bit shorter, so that it will cut a recess only $\frac{5}{8}$ in. diameter—you needn't bother about "mike measurements" here—and cut a clearing recess, $\frac{1}{16}$ in. deep, at the bottom of the larger one; see sectional illustration. This prevents any tendency of the middle part of the ball bearing to rub on the axlebox, and is very desirable when self-aligning bearings are used, as the middle part has then perfect freedom to tilt.

Should needle bearings be available, drill the axle holes just large enough to let the axles run free; I gave my own 1/32 in. overall clearance. Then make up a pin-drill, from a piece of silver-steel, of suitable diameter. In my own case, I already had a $\frac{7}{16}$ in. pin drill; I have a small drawer full of them, mostly home-made. However, this one only had a $\frac{1}{4}$-in. pilot pin, but that didn't matter a Continental; it was adapted in a matter of minutes, by aid of a bush or sleeve, slipped over the pin. A piece of mild-steel was chucked in the three-jaw, about $\frac{3}{8}$ in. of it turned to a running fit in the hole in the axlebox, and it was then centred, drilled with letter "D" drill, and parted off. When pushed on to the pin, I had a $\frac{7}{16}$-in. pin-drill with the correct size pilot, and it was the work of a few minutes only, to recess my four axleboxes to $\frac{7}{16}$ in. depth, to take the Torrington bearings. I gauged the depth of the recess by aid of the graduations marked on the quill of my pedestal drilling machine, and did not use the adjustable positive stop with which the machine is provided; but inexperienced workers could arrange a stop, after the style of those I specify for use when reaming injector cones, viz. a brass bush with a set-screw, to fix on the drill.



Arrangement on "L.B.S.C.'s" own engine

Plain Bearings

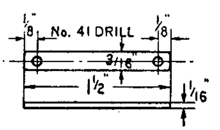
If plain bearings are used, the boxes on one side of the bogie are marked off and drilled with a small drill, say No. 30, and used as jigs to drill similar holes in the corresponding boxes on the opposite side, as described for coupled axleboxes; they are then fitted to the bogie frame, and each pair of boxes checked by putting a piece of $\frac{1}{8}$ in. straight silver-steel through the holes. These test rods should be exactly at right angles to the bogie frame, and parallel to each other. When first attempting to put the axleboxes in position between the horncheeks, it will probably be found that they are either very tight, or may refuse to go in at all. The total width of the $\frac{1}{2}$ in. angle, plus the $\frac{1}{8}$ in. of the bogie frame, may be too much for the distance between the axlebox flanges. If that proves to be the case, don't thin the flanges on any account, but file a weeny bit off the angles, so that the flanges on the boxes will slide over them easily. I had to take about 1/64 in. off mine, which allowed the boxes, not only to slide easily, but to tilt a little either way. Jupiter Pluvius, Breezy Boreas, and King Sol combine to take an unholy delight in trying to convert my railway into a miniature switchback route, embodying a succession of minute "'umps and 'ollers"; and although I do my best to counteract their nefarious work, it occasionally happens that we get a depression or two, and maybe an occasional low joint. The engine wheelbase has therefore to be flexible enough, in all directions, to follow the road at a good clip, without coming off; ergo, as Hamlet would remark, a little "tiltability" (as my one and only niece would have said when a schoolgirl) in the axleboxes, is very desirable. The "precision brigade" always amuse your humble servant, with their instructions for exact fits *everywhere*, not realising that play is necessary in some places; they just won't "come down to earth"—but an engine without sufficient freedom in the right places, jolly soon would, literally, by jumping the road at the least provocation!

When the pilot holes are correct, if the axleboxes are made from bronze or cast-iron, open

out with 23/64-in. drill, and ream $\frac{3}{8}$ in. Same applies to a solid whitemetal box; but if the boxes are of "makeshift" metal, open out to 31/64 in., and fit bronze bushes. It would be a poor home workshop that couldn't produce a bit of $\frac{1}{2}$ in. bronze or gunmetal rod, from which to turn them. Chuck the rod, and turn it to a tight squeeze fit in the holes in the boxes, then face, centre, and drill it 23/64 in. Part off a little longer than the width of box; press home, then file flush both sides of box, and poke the $\frac{3}{8}$-in. reamer through. I save all my cut-off chucking pieces to make bushes for jobs like this —vot you tink, eh? Hoots, mon, awa' wi' ye!

The boxes could be white metalled very easily. After drilling the holes to $\frac{1}{2}$ in. diameter, chuck each box in four-jaw with the hole running truly (it needn't be exact) and turn a small groove inside, with a bent tool made from the tang end of an old file. Lay the boxes on a bit of asbestos millboard, give the holes a dose of Baker's fluid or other liquid soldering flux, heat them to the melting point of solder, and pour in some melted babbit or other antifriction metal. When it has cooled and set, the axleboxes can be re-drilled and reamed, same as if they were solid metal. Whether the boxes are bushed or not, don't forget to drill an oil-hole in the top of each, as shown by dotted lines in the side view. Use a $\frac{1}{16}$-in. drill, put in on the slant, and countersink the top.

There are just two more points to note. As the tops of the openings in the bogie frame have rounded corners, the upper edges of the axleboxes, in the channels, must be filed off to suit. This is shown by dotted curves in the broadside views of both the plain bearing and ball-bearing boxes. A depression must also be made in the top of each axlebox, to accommodate the projections at the ends of the equalisers, and prevent them shifting about on top of the boxes. The equalisers and springs will be shown, if all's well, in the next instalment. On the centre-line of the box, and at $\frac{5}{16}$ in. from the front (that is, the side nearest to the wheel) make a heavy centrepop, and turn it into a countersink by aid of a $\frac{5}{16}$-in. drill. This is shown both in the plan



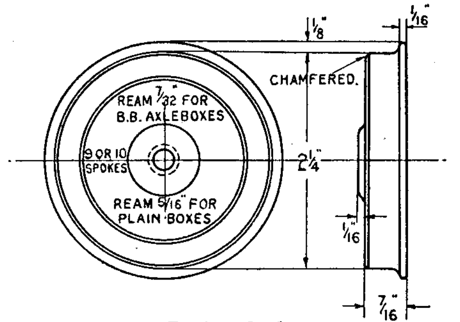
Bogie hornstays

view, and by dotted lines on the inner face view of the ball-bearing axlebox.

The axleboxes are prevented from falling out of the horns, by simple hornstays which are merely $1\frac{1}{2}$ in. lengths of $\frac{3}{16}$ in. $\times$ $\frac{1}{16}$ in. steel strip, rounded at the corners. They have No. 41 holes drilled at $\frac{1}{8}$ in. from each end, and are attached to the bogie frames, under the axleboxes, and level with the bottom line of frame, by two 3/32 in. or 7-B.A. screws running into tapped holes in the bogie frames.

Wheels and Axles

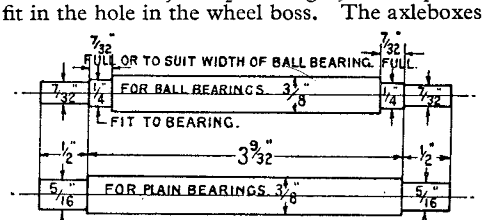
The bogie wheels are $2\frac{1}{4}$ in. diameter on treads, with $\frac{1}{16}$ in. rounded flanges $\frac{1}{8}$ in. deep The roots of the flanges are well rounded off, as shown, which cuts down the flange friction on curves, and makes for easy running. The treads are cylindrical, or parallel, and the edges are slightly chamfered. As the wheels can be turned by exactly the same process as described for the coupled wheels, and all except the treads may be done in the three-jaw chuck, there is no need to detail out the whole job again. The big engines



Bogie wheels

have nine-spoked wheels, but stock castings having ten spokes, as on my own engine, may be used. Note that if ball or needle bearings are used, the wheels should be drilled and reamed to 7/32 in., but if plain bearings are used, this may be increased to $\frac{5}{16}$ in. to make the strongest possible job.

The axles are turned from $\frac{3}{8}$ in. round mild-steel. The axle for the plain bearings is simply chucked in the three-jaw, taking the usual precautions if the chuck isn't as true as it ought to be, and the ends turned to a squeeze fit in the holes in the wheel bosses, as per previous instructions. For ball bearings, first of all turn down the end for a bare $\frac{3}{4}$ in. length, to a good push fit in the hole in the bearing; then further reduce the ends, for $\frac{1}{2}$ in length, to a squeeze fit in the hole in the wheel boss. The axleboxes

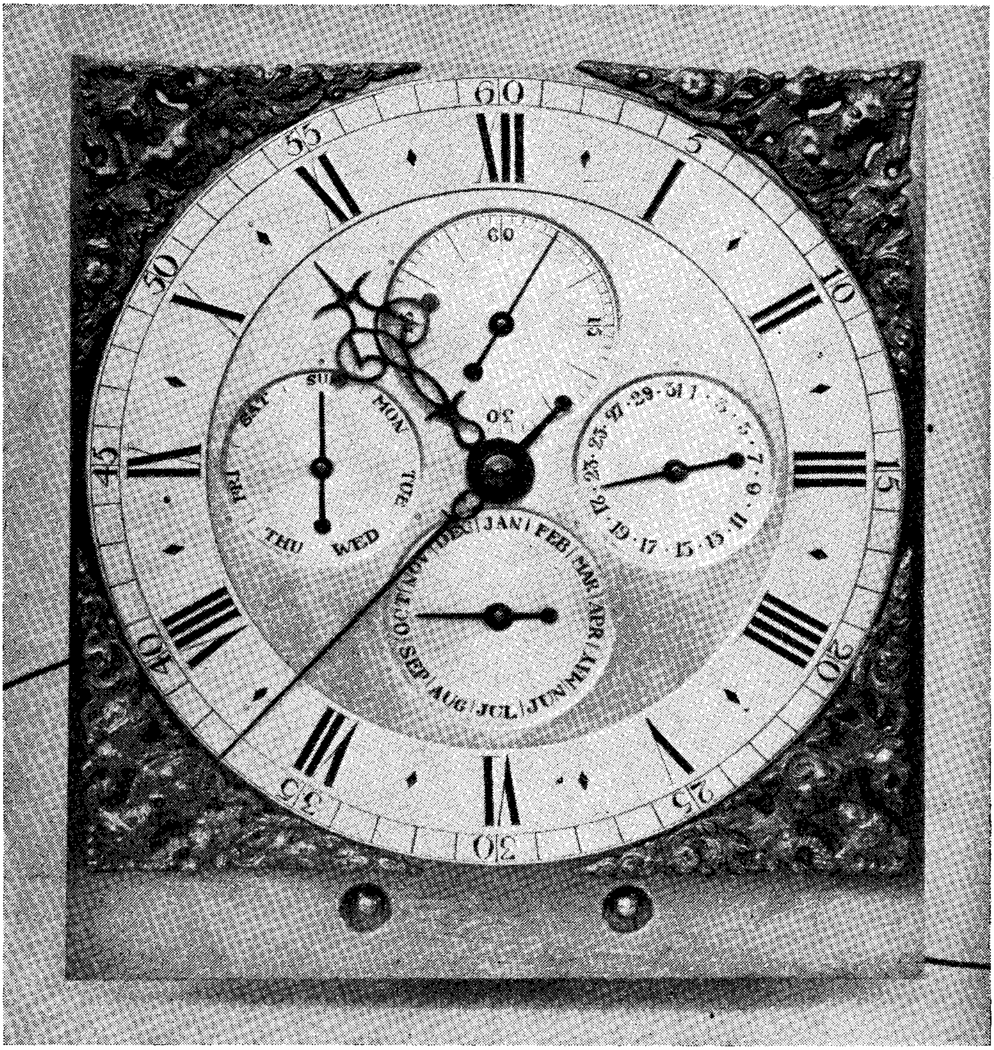


Bogie axles

are put on with the ball-bearing next to the wheel, and the wheel is very carefully pressed on, so as to avoid bending the seating. Too tight a fit is not needed here, as there is no driving stress; as long as the wheel is secure from coming off, it is O.K. The axles on my own engine were turned down to $\frac{1}{4}$ in. each end, for a length of 1 in. full, to fit the Torrington bearings, and further reduced a weeny bit, to fit the holes in the wheel bosses, which I had reamed with a 6 mm. reamer. The whole doings, as fitted on my own engine, is shown in the detail illustration, which will help anybody who is able to fit this kind of bearing. My bogie runs very freely indeed. Next item, springing and erecting bogie.

CONSTRUCTING A YEAR CLOCK

by C. B. Reeve



The dial

PASSING one day with a friend through the medieval section of the British Museum, the writer's attention was called to the fine example of Tompion's very tall one-year clock with its handsome dial and beautifully shaped and chased hands. A closer inspection through the sides of the case revealed that the great or first wheel of the movement was of enormous size, probably about seven or eight inches in diameter. This gave the writer the urge to construct a year clock, but he considered it would have to be on somewhat different lines, as his domain, having low-pitched ceilings, no clock of more than five or six feet would fit in comfortably. It is proposed in this article to state briefly how this clock was made and to give some details to enable interested readers to construct a similar clock.

It is generally thought that horological tools are essential for a job of this description ; this is not so, really. Such tools, of course, are convenient, but ways and means will be shown how the ordinary run of tools of the average model engineer's workshop will accomplish the job. A start on the movement was made during the

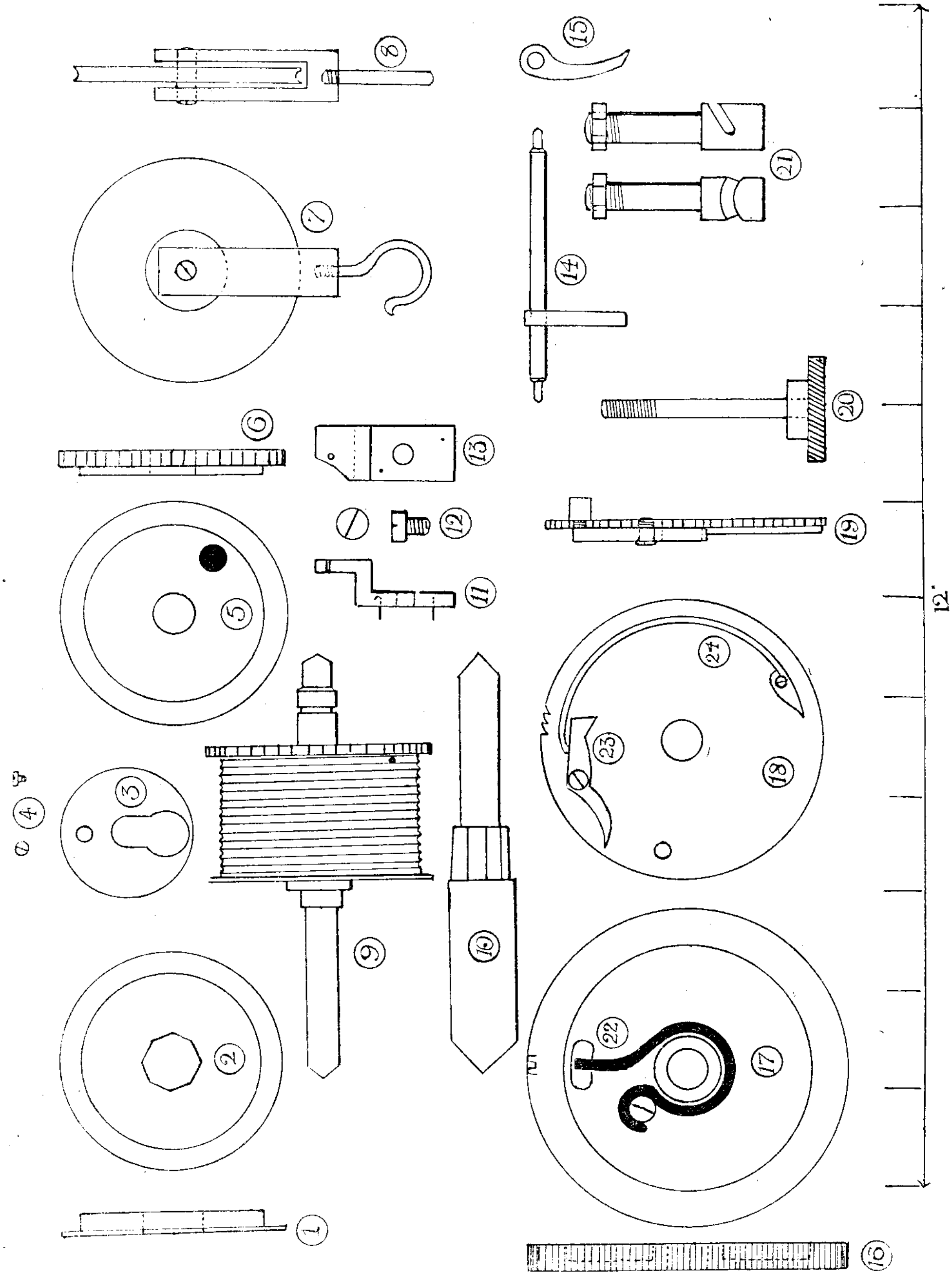
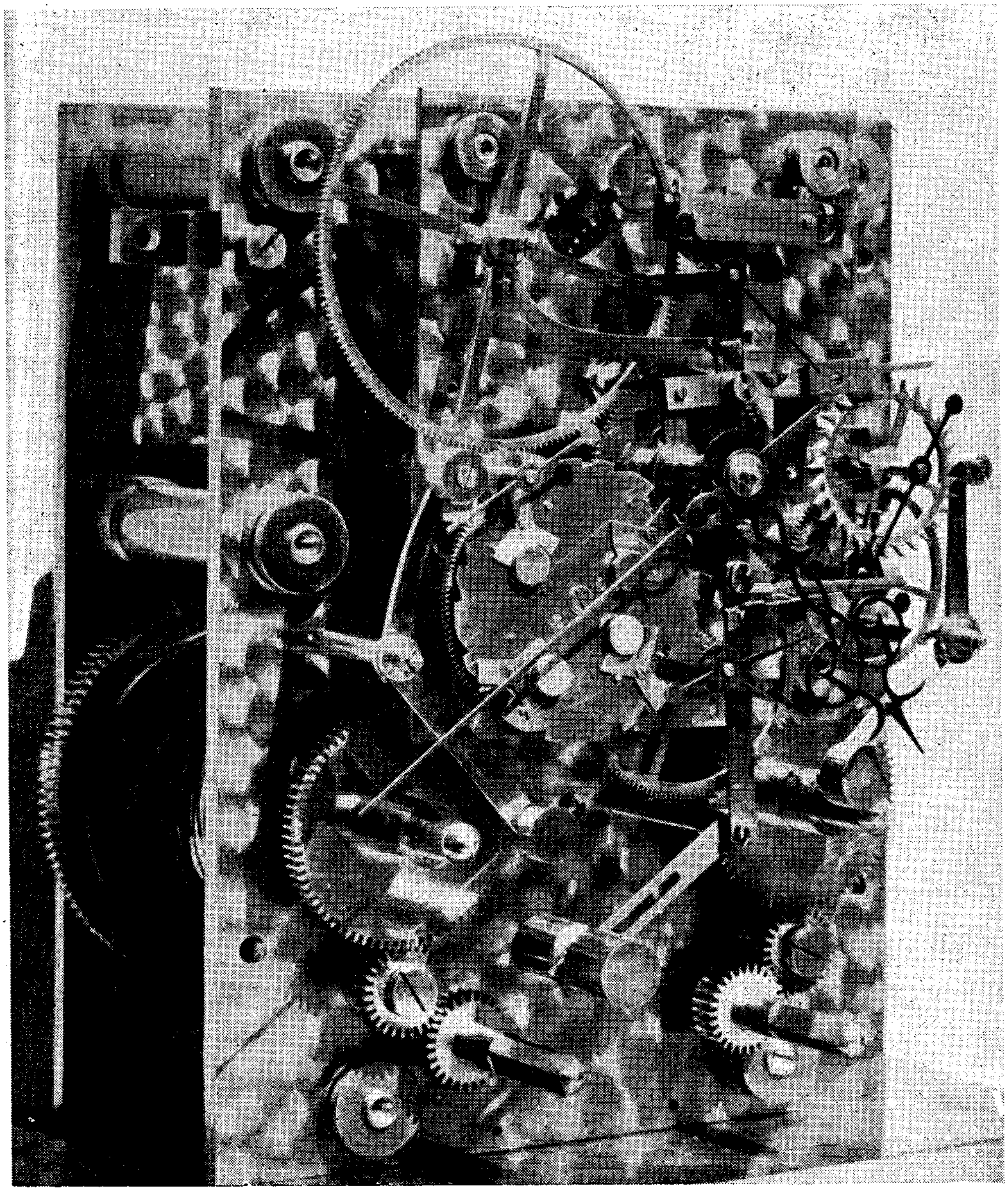


Fig. A

opening week of the Model Engineer Exhibition of August 17th, 1949.

The two driving barrels were built up in the following way: a 12 in. length of $\frac{5}{8}$ in. diameter silver-steel was cut in half to form the arbors of the barrels and were turned to the shape and size as indicated in the data table and shown in the drawings, which are to scale. It will be seen from the drawing that part of the arbor is rough filed eight-sided with a slight taper; next, a circular brass blank $\frac{1}{4}$ in. in thickness by $2\frac{3}{8}$ in. diameter was centrally drilled of such a size hole that it could be filed eight-sided and made a drive-on fit on this arbor; it was driven well home and formed a nice snug fit on the arbor. The latter was then placed between centres in



Front view of movement

the lathe and a step turned on the flange slightly less than $\frac{1}{8}$ in. in width and the diameter in size to fit closely a piece of previously prepared brass tube 3/32 in. thick and to the dimensions shown in the drawings. The back flange on which the ratchet teeth were cut later was turned on a separate mandrel. The arbor, with the already mounted front flange, was then turned parallel, as shown in the drawing, for the reception of the back flange which was a good press-on fit. With all three parts finally fitted together, three locking pins were put through the tube at either end into the steps of the flanges as shown. Finally, a slight turning all over of both flanges and tube produced a perfectly true barrel and arbor. The barrel was next screw cut for the reception of the driving line. It is worth mentioning that the barrels will work quite satisfactorily if they are not screw cut for the driving line. Many of the old clock-makers did not trouble to do this. Ratchet teeth were then cut on the back flange of the barrel with the aid of a home-made cutter,

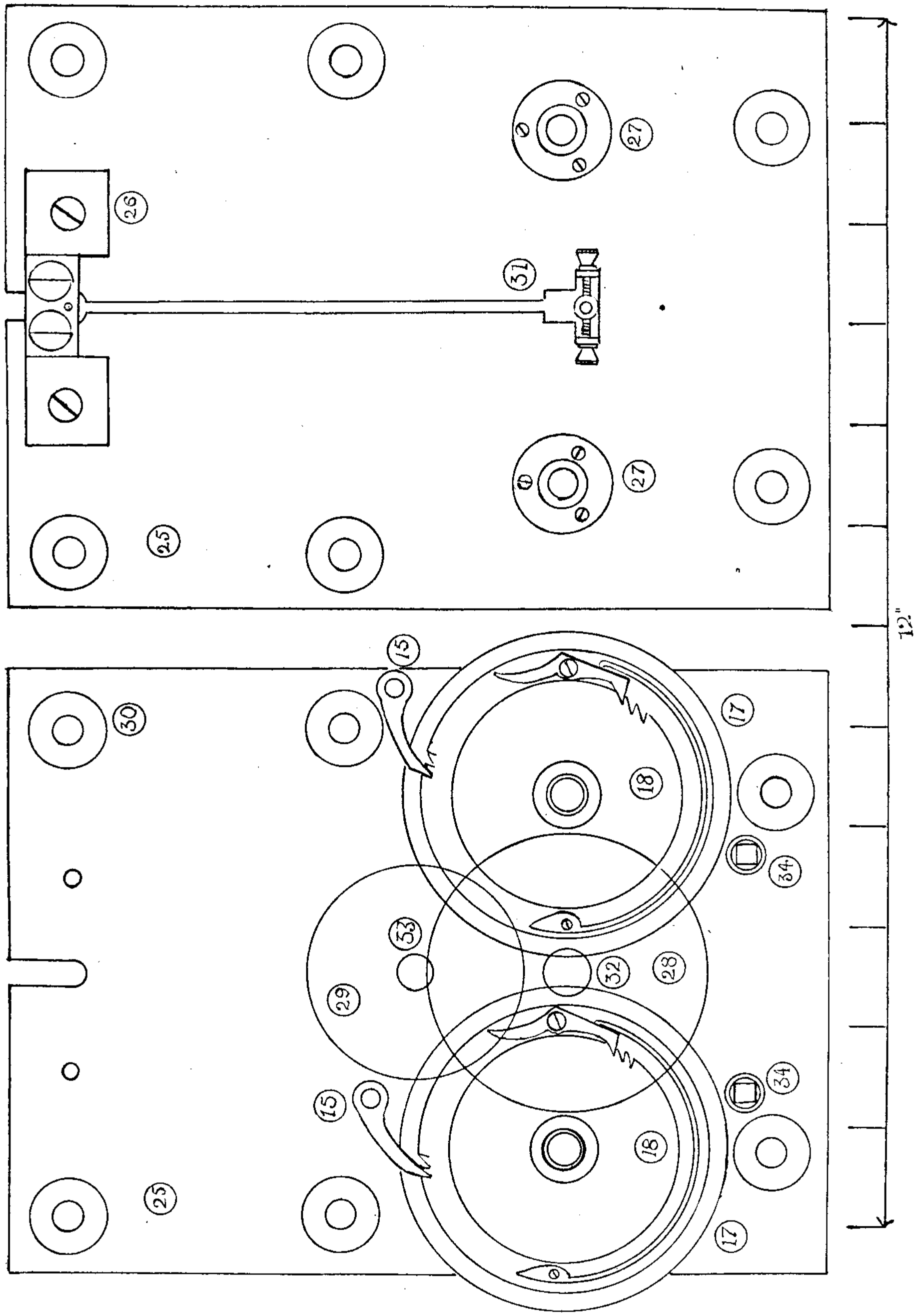


Fig. B

the barrel being placed between centres with the division plate on the end of the mandrel and the cutter frame on the slide-rest.

Maintaining Ratchet

This was made as shown in the drawing, the same home-made cutter being used as that with which the barrel teeth were cut.

Click and Spring

The components were quite a straightforward job, being a pure handwork operation, the click being made of steel and the spring cut from brass sheet with a piercing saw and afterwards bent to the required circular shape.

The wheels were next taken in hand ; circular milling-cutters were used for cutting the teeth.

Details of the pitches and diameters are shown in the data table. The following method was adopted for producing the larger wheels: A circular brass blank for the great wheel of the appropriate thickness and $\frac{1}{8}$ in. in diameter larger than the required wheel was to be drilled and bored, a good revolving fit on the barrel arbor, the blank being held in the self-centring chuck for this purpose. Next, a short piece of round brass or steel rod was chucked in the self-centring chuck with the lathe jaws in position, so arranged as to leave about three-quarters of an inch protruding beyond the longest steps of the chuck jaws. This was now turned down to fit the previously prepared hole in the blank wheel. Afterwards, the end of the rod was threaded with a die and a nut made and fitted. The blank wheel was now pushed on to the short end of the truly running rod and resting firmly against the chuck jaws, the nut was now screwed home, taking care not to force the latter too much. The blank wheel held thus was then turned down to size. The division plate was then fitted on the tail-end of the mandrel and the cutter frame fitted to the slide-rest, the cutter being driven from the countershaft. Wheels produced this way came out with the teeth and bores dead true with one another. The smaller wheels were produced the same way except that these were fitted to some small home-made chucks made to fit the mandrel bore of the lathe. The wheels were next crossed out, a piercing saw being used for this purpose, followed by files and emery sticks for fine finishing. A piercing saw is an extremely useful tool for any form of model engineering or instrument work; steel up to a quarter of an inch can be cut with it, the finishing required afterwards being far less than when other tools have been used.

Data Table to Drawings

Reference		Description of items	Number of teeth	Full Diameter (in.)	Width (in.)	Diametrical pitch	Quantity required
Fig. A.	1.	Front flange of driving barrel	—	—	—	—	—
"	2.	" " " "	—	—	—	—	2
"	3.	Key or slip washer	—	—	—	—	2
"	4.	Locking screw to slip washer ..	—	—	—	—	2
"	5.	Back flange of driving barrel ..	—	—	—	—	—
"	6.	" " " " " ..	—	—	—	—	2
"	7.	Shackle and pulley	—	—	—	—	—
"	8.	" " "	—	—	—	—	2
"	9.	Assembled barrel	—	—	—	—	2
"	10.	Partly machined arbor of barrel	—	—	—	—	2
"	11.	Cock for back pivot of centre arbor	—	—	—	—	1
"	12.	Fixing screw for above ..	—	—	—	—	1
"	13.	Plan view of cock for back pivot of centre arbor	—	—	—	—	—
"	14.	Maintaining click	—	—	—	—	—
"	15.	" "	—	—	—	—	2
"	16.	Great or first wheel of train ..	112	$3\frac{1}{4}$	$\frac{1}{4}$	34	
"	17.	" " " " " " ..	"	"	"	"	2
"	18.	Maintaining ratchet	100	$2\frac{7}{8}$	3/32	—	
"	19.	" "	"	"	"	—	2
"	20.	Set screw for holding movement to seat board ..	—	—	—	—	2
"	21.	Hook for holding ends of driving line of barrel ..	—	—	—	—	2
"	22.	Maintaining spring	—	—	$\frac{1}{4}$	—	2
"	23.	Click for barrel teeth	—	—	$\frac{1}{8}$	—	2
"	24.	Spring for click	—	—	—	—	2
Fig. B.	25.	Back plate of movement ..	—	—	—	—	—
"	26.	Cock for escapement pivot and pendulum suspension bracket	—	—	—	—	—
"	27.	Bearing for great wheel pivot ..	—	—	—	—	4
"	28.	Second wheel of train	112	$2\frac{3}{4}$	$\frac{1}{8}$	40	1
"	32.	Pinion on 2nd wheel of arbor ..	12	.400			1
"	29.	Third wheel of train	108	$2\frac{1}{8}$	1/16	52	1
"	33.	Pinion on 3rd wheel of arbor ..	12	.332			1
"	30.	Ring nut for pillar	—	—	—	—	12
"	31.	Crutch of escapement ..	—	—	—	—	1
"	34.	Winding arbor of movement ..	—	—	—	—	2

(To be continued)

A Worm-driven Fine Feed

by C. R. Jones

WHEN the writer took delivery of a new Myford M.L.7 lathe last year, almost the first thing to be made on it was a slow-feed arrangement, somewhat similar to that described by him for a 3-in. Winfield lathe in THE MODEL ENGINEER issues of February 19th, 1942, and May 23rd, 1946, as it had been found most useful and quiet in its operation, and is, in fact, still in use.

The one made for the Myford is shown by the photographs, and also the drawings. It will be seen that the worm, its shaft, and the bearings for same, are carried on a mild-steel bracket, which is hinged to a small plate, secured to the lathe quadrant by means of one set-screw.

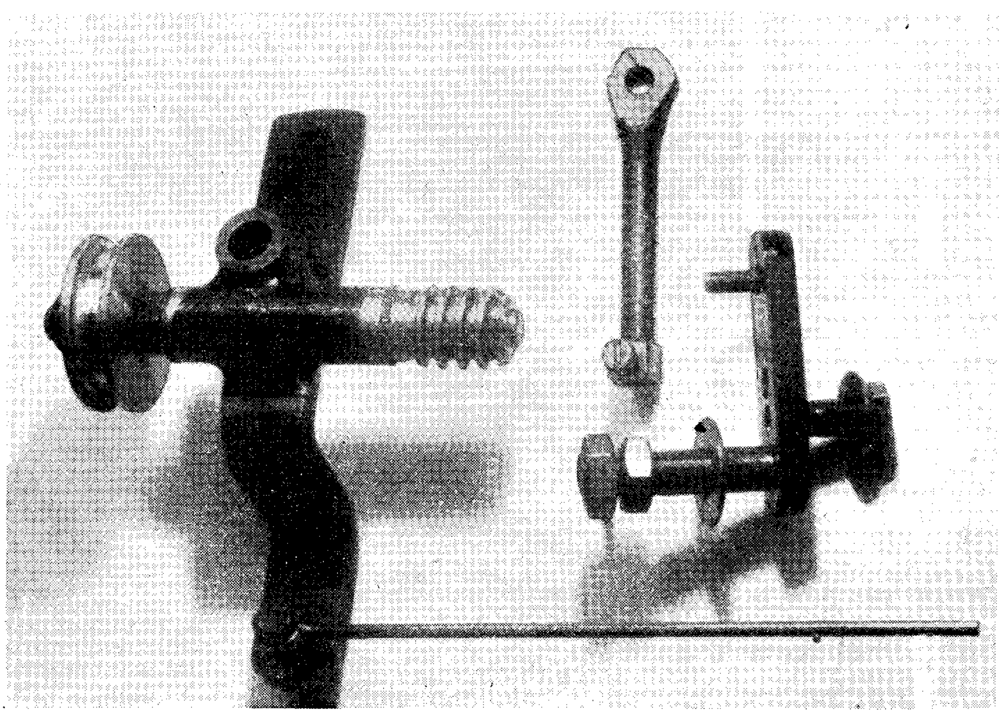
The worm can be thrown in or out of gear (with the changewheel affixed to the leadscrew) by means of an adjustable link, and a control shaft, furnished with a ball lever, the position of which, in the present case, is at the front edge of the lathe bench, just in line with the tailstock end of the gap in the lathe bed.

The set-up shown in the photograph has a 50-tooth wheel on the leadscrew, and gives a 400 to the inch feed. Larger wheels can be used if desired, giving a still finer feed, and this arrangement also enables the changewheel guard supplied with the lathe still to be used to enclose the gears.

As shown, the drive (by sewing-machine belting) is taken from the lathe mandrel by means of a mandrel adapter and pulley. This seems a much quieter arrangement than driving off a pulley fixed to the cluster gears, and saves wear on them ; but, of course, this arrangement stops the full length of the hollow mandrel being made use of, though a pulley was made at the same time to fit on the cluster gears, so that the mandrel could be used for long stock if necessary, and works quite satisfactorily with a shorter belt.

The component assemblies are shown on one photograph, the swivelling bracket with its worm, pulley and bearings, being on the left, and the control-rod which connects up with the adjusting link is shown attached to it. The adjusting link is shown at the top centre, and the hinge bracket, with its hinge stud, lock-nuts, stop pin and the set-screw for attaching it to the lathe quadrant, is shown on the right.

The drawings give the measurements necessary to construct this fine feed. The bracket (*A*) was in this case made from a piece of flat mild-



Component assemblies

steel $\frac{7}{8}$ in. × $\frac{1}{8}$ in., although 1 in. × $\frac{1}{8}$ in. would be quite satisfactory. This was cut and bent to the dimensions shown, a $\frac{1}{2}$ in. diameter hole being drilled in the top portion in the position shown, the rear side of which was slightly countersunk, and a $\frac{3}{16}$ in. diameter hole for the control was drilled in the lower portion.

The portion (*B*) was made from $\frac{5}{8}$ in. diameter mild-steel as shown, the $\frac{1}{2}$ in. diameter portion being turned a tight fit for the $\frac{1}{2}$ in. hole in the portion (*A*) and was riveted over at the rear side into the countersink previously mentioned.

A $\frac{3}{8}$ in. diameter hole was drilled right through (*B*) at the same time as the $\frac{1}{2}$ in. portion was turned. The portion (*C*) was a $1\frac{1}{2}$ in. length of $\frac{5}{8}$ in. diameter B.M.S. and was set up in the lathe and a $\frac{3}{8}$ in. diameter hole drilled right through, the ends then being bored out to $\frac{7}{16}$ in. diameter for a distance of just over $\frac{7}{16}$ in., to accommodate the bushes.

A groove was then filed across (*C*) in the position indicated on the plan view of worm assembly, to fit snugly on the underside of portion (*B*) so that (*C*) sits at about the angle indicated. This angular position is to ensure that the pulley and belt clear the lathe quadrant when the attachment is in position, and also to bring the teeth of the worm parallel with the teeth of the changewheel in use.

Care was taken that the groove was not made deep enough to break through into the axial hole. Piece (*C*) was then wired on to piece (*B*) in the correct position, and in the present case the whole was brazed together, but I see no reason why it should not have been silver-soldered.

When the assembly had been cleaned up, the two bronze bushes (*D*) were made and pressed into the ends of (*C*), afterwards being reamed to $\frac{5}{16}$ in. diameter.

A bronze worm was turned up to the dimensions shown, the lathe being set up for cutting six threads per in. This worm was made with a *left-hand* thread, as it works under the changewheel, and so brings the threads at the top parallel with the changewheel teeth.

The spindle was made from $\frac{5}{16}$ in. diameter silver-steel and was threaded at one end to accommodate the pulley, and the two nuts, the worm being made a press fit on the other end. A fibre washer was inserted at each side of the bearings as shown in the drawing, and as the nut nearest the bearing was counter bored for a short distance, a limited amount of adjustment for end float was secured.

The pulley was made of duralumin to the dimensions shown and has a $\frac{5}{16}$ in. diameter hole through its centre.

Hinge bracket (*E*) was made from $\frac{3}{4}$ in. × $\frac{1}{4}$ in. mild-steel to the sizes shown. Three-eighths of an inch from the lower end a $\frac{5}{16}$-in. hole was drilled, and from the centre of this hole, two other holes were drilled at $\frac{3}{8}$-in. centres, tapping size for $\frac{5}{16}$-in. Whitworth, the hole at the top end for the $\frac{3}{16}$-in. pin being left for the moment.

A $\frac{3}{8}$ in. diameter stud was made with the lower end turned down to $\frac{5}{16}$ in. diameter for a length of $\frac{5}{16}$ in. a good fit in the $\frac{5}{16}$-in. hole in (*E*), the hole being countersunk and the stud firmly riveted into position. The $\frac{3}{8}$ in. portion of the stud was $1\frac{1}{2}$ in. in length, the outer end being furnished with a B.S.F. thread $\frac{5}{8}$ in. long. The $\frac{3}{8}$-in. stud was then inserted in the $\frac{3}{8}$-in. hole in portion (*B*) of the swivelling bracket, a lock-nut being put on and screwed up tightly with the two vertical portions of the brackets parallel.

A $\frac{3}{16}$ in. diameter hole was then drilled through both brackets at the top where indicated, and after separating the brackets, a silver-steel pin was pressed into the hole in the hinge bracket (*E*). The hole in the swivelling bracket being later slotted out with a round file to work over the pin (before mentioned) and to give sufficient movement to allow the worm to engage and disengage with the change wheel in use.

The two holes marked $\frac{5}{16}$-in. Whitworth in bracket (*E*) were then tapped with this thread, and a set-screw and washer used to fix the hinge bracket in position on the lathe quadrant, using the lower tapped hole, and passing the set-screw through the lower slot in the quadrant.

The swivelling bracket was again assembled on the hinge bracket, a steel washer $\frac{1}{16}$ in. in thickness being first placed on the $\frac{3}{8}$-in. stud and the two lock-nuts put on and adjusted to give free movement without shake.

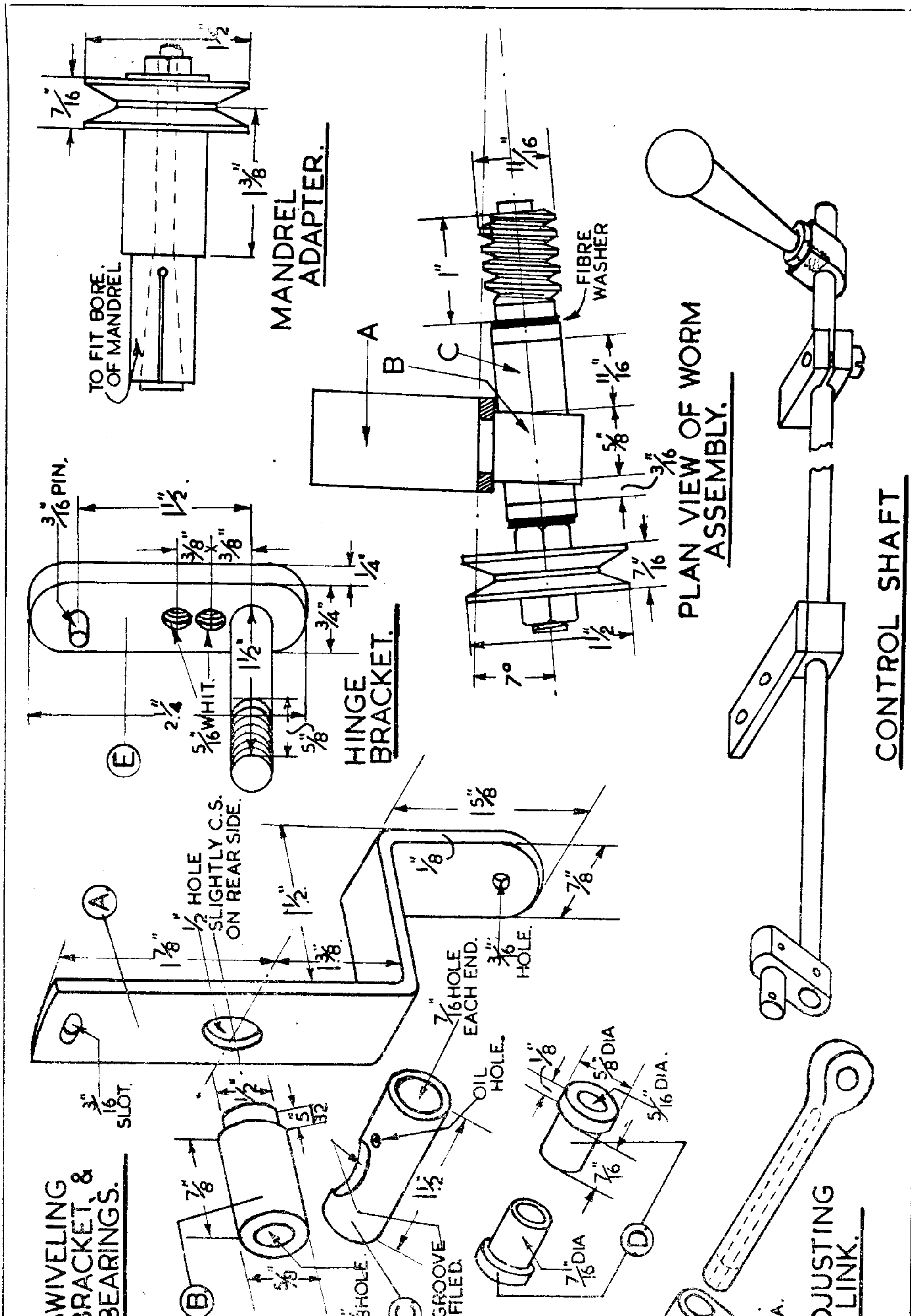
A suitable changewheel was then fitted to the leadscrew, the keyed collar being first placed on and the wheel held in position by the set-screwed collar. It was then found that the worm positioned correctly in the centre of the changewheel teeth.

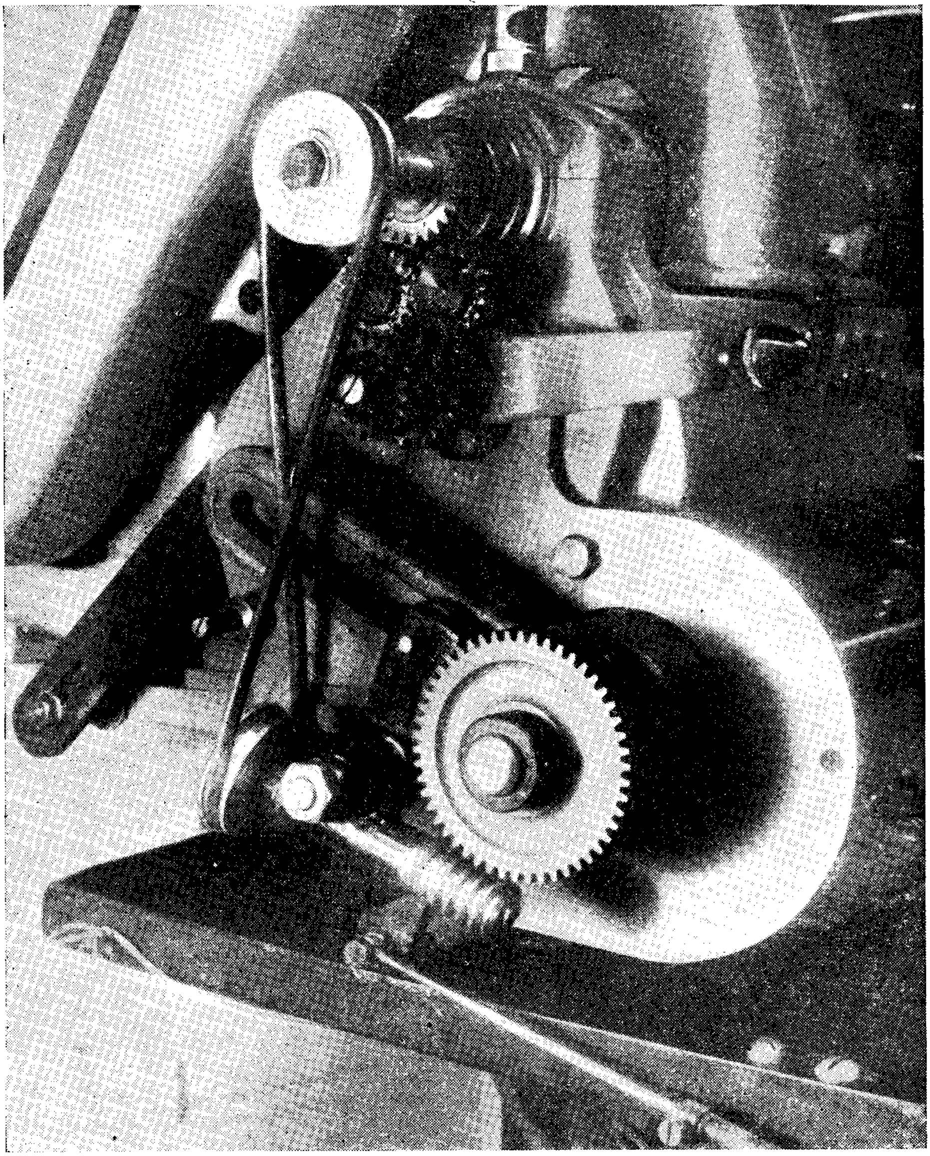
The next thing made was a mandrel adapter for the lathe spindle, but as many of these have been described in THE MODEL ENGINEER before, it is not intended to go into this more fully. The only important dimension is given on the drawing. The pulley made for this was almost identical to the other, except that it was bored out to the same bore as the changewheels, in order that one could be used for dividing if desired.

A belt being fitted, the arrangement was tried out and found to work satisfactorily. The slot in part (*A*) working on the pin in (*E*), limits the movement of the worm in and out of gear, but a manually-operated control was necessary for convenience, and to lock the worm into engagement.

A rod made from $\frac{1}{8}$ in. diameter silver-steel, with an eye portion screwed and silver-soldered on to one end was connected to the lower end of bracket (*A*) by means of a shouldered bolt and nut. Fixed to the other end was an adjusting link, made from a $\frac{5}{16}$ in. steel bolt, the head of which was heated and roughly forged to form an eye, which was drilled $\frac{1}{4}$ in. This bolt was drilled up for about 2 in. with an $\frac{1}{8}$ in. drill, and a small piece of $\frac{7}{16}$ in. square material was drilled with a $\frac{5}{16}$-in. hole and soldered on to the open end of the bolt, after which it was shaped and drilled as shown on the drawing, and tapped and provided with a No. 3 B.A. set-screw.

This adjusting link can be slid on to the $\frac{1}{8}$-in. rod, before described, and can be adjusted for length, and locked with the set-screw. The $\frac{1}{4}$ in. diameter hole in the adjusting link fits on to the small crank on the control shaft which is affixed to the left-hand end, and has two bearings which are screwed to the underside of the front of the lathe bench.


MANDREL ADAPTER.
TO FIT BORE OF MANDREL.
PLAN VIEW OF WORM ASSEMBLY.
FIBRE WASHER
CONTROL SHAFT
HINGE BRACKET.
3/16" PIN.
5/16" WHIT.
SWIVELING BRACKET & BEARINGS.
1/2" HOLE SLIGHTLY C.S. ON REAR SIDE.
3/16" SLOT.
3/16" HOLE.
7/16" HOLE EACH END.
OIL HOLE.
3/8" HOLE.
GROOVE FILED.
ADJUSTING LINK.
No. 3 B.A.



View showing fine feed in position on lathe

The right-hand end of the shaft is provided with a ball-ended lever for operating. There is also a stop provided, which can be adjusted to come up against the underside of the bench when the worm is in engagement and the crank has just gone over the front horizontal dead centre. This efficiently stops the worm from disengaging until the lever is operated for this purpose.

The crank was made from $\frac{3}{8}$ in. square steel drilled with two $\frac{1}{4}$ in. diameter holes at $\frac{5}{16}$ in. centres, one for the crankpin and the other for the 13 in. length of silver-steel which forms the control shaft.

The two bearings were made from two pieces of $\frac{3}{8}$ in. square brass rod, silver-soldered to $\frac{1}{2}$ in. $\times$ $\frac{1}{8}$ in. flat steel and drilled to take the control shaft and provided with holes for bolting to the bench. The stop was a piece of the same brass drilled $\frac{1}{4}$ in. and split and provided with a set-screw for adjusting.

The ball handle was screwed into the boss on the control shaft and made to grip on a flat made on the shaft in the correct position.

The adjusting link slips over the crankpin and is secured by means of a small split-pin only slightly opened to ensure easy removal. By removing this split-pin and the $\frac{5}{16}$ in. set-

(*Continued on page* 112)

A Model Gas Engine

by W. E. Atkinson

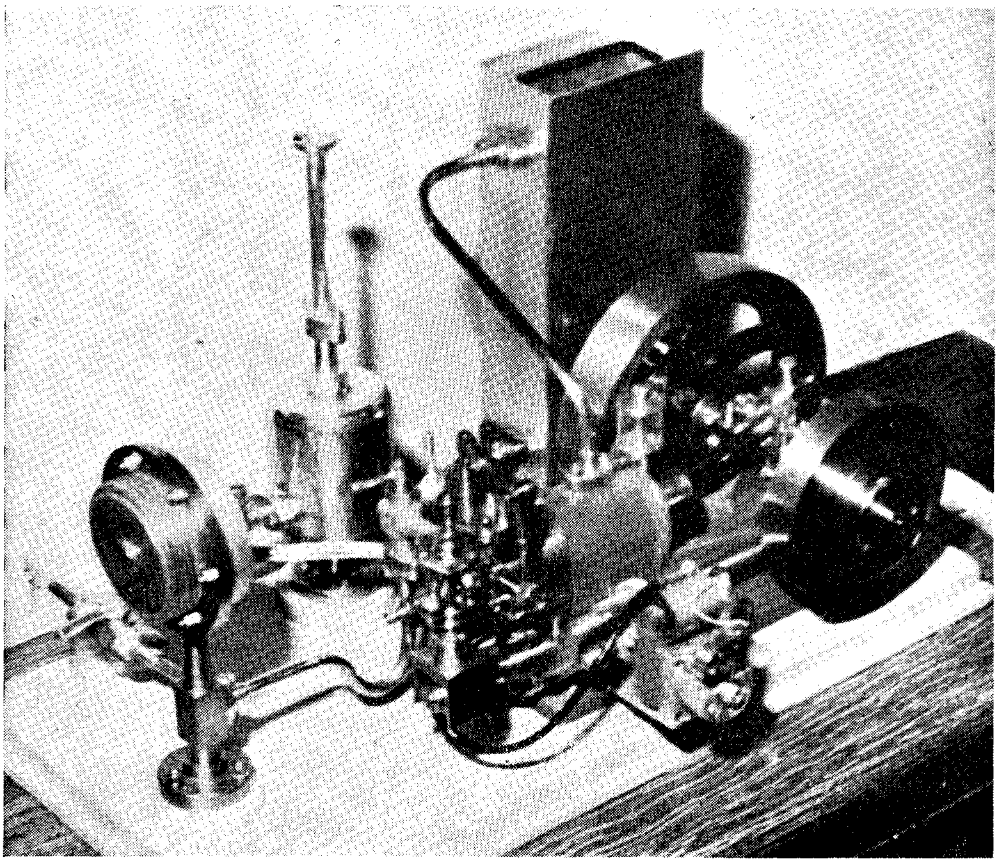
THE photographs reproduced herewith show a model of a gas engine which I completed in 18 months, working mainly at week-ends.

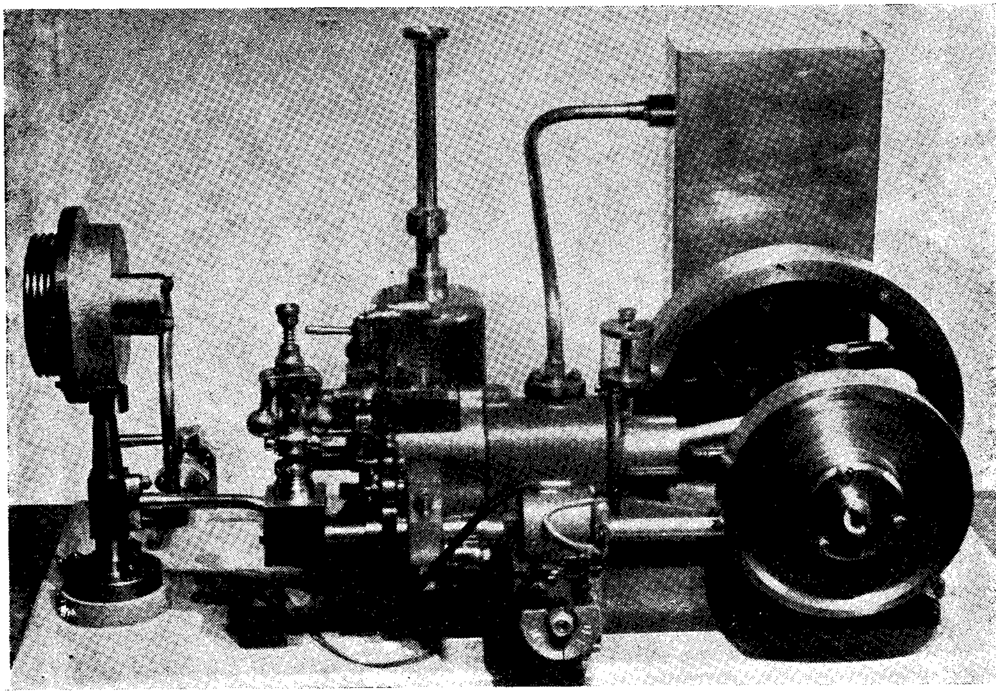
The model is intended to represent a low power industrial gas plant, such as were popular in small workshops before the advent of cheap electricity ; but it is not a scale model of any particular engine.

The basis is a set of castings I purchased before the war. Some of these I rejected as unsuitable ; gunmetal for the rockers, and cast-iron cams did not appeal to me, so I fabricated such parts from mild-steel stock. I also improved on the design a little by fitting adjustable tappers to the rockers, and a simplified governor linkage. The magneto was purchased and fitted in place of the contact-breaker for coil ignition ; although it was rather oversize, I decided to put up with that in preference to a coil and batteries, the idea being that a demonstration run could be given by simply connecting to the gas supply and giving a swing. Unfortunately, I overlooked the amount of water which is present in ordinary household gas, and which necessitates stripping down and cleaning the cylinder-head after each run, to prevent rapid and excessive corrosion of the valves.

The bore of the cylinder is 1 in. diameter and the stroke of the piston $1\frac{1}{2}$ in. The cylinder is in the form of a wet liner, and the piston is of cast-iron, fitted with four compression rings.

The crankshaft is supported by three main bearings which, together with the big-end bearing, are split and adjustable. Both gas and mixture valves are mechanically operated off one cam, but the opening of the gas valve can be independently adjusted by a screw tapper. The control valve is a plunger working over a





port in the gas manifold ; it is operated through a linkage from the governor, and at the same time can be screwed in and out by means of a hand wheel on the outer end of the plunger.

The gas bag bellows is a section cut from the bellows to be found inside a bomb sight computor ; it was just the right size and much more satisfactory than the usual sheet of rubber.

After completing the machining, up to the cylinder-head, and fitting the valves, I found a persistent leakage, during compression, past the exhaust valve. A close inspection of the combustion chamber showed a small section of porous metal extending down into the exhaust passage. I did not like the idea of scrapping the whole cylinder-head, so decided to bore out the exhaust valve passage and fit a sleeve reseating the valve on the end of the sleeve. An inspection of the scrapbox showed the only piece of cast-iron available to be a fearsome-looking chunk which had once seen service as a sash weight ; however, after getting through the awful exterior, I got quite a nice piece of close-grained cast-iron, and the job was finished with satisfying results.

The paint is cellulose enamel, which gives a much more durable finish than oil paint, and contrary to what is generally accepted, it can be brush worked without difficulty if the right amount of " retarder " (i.e. commercial castor oil) is added.

The various parts are mounted on a cast-iron base which in turn is mounted on a piece of stained oak, the whole layout giving quite a pleasing effect.

A WORM-DRIVEN FINE FEED

(*Continued from page* 110)

screw retaining the hinge bracket, the whole arrangement can be removed from the lathe.

The changewheel guard can be used with this arrangement, but it will be necessary to make two packing washers about $\frac{5}{16}$ in. in thickness, which are slipped on the two studs which support it in position. It was also found necessary to lengthen the studs themselves by this amount, as well as to drill the hole in the rear of the guard deeper to accommodate these longer studs when the fine feed was removed from the lathe. The knurled nut which retains the guard at the front of the lathe was also drilled through its blind end for this purpose.

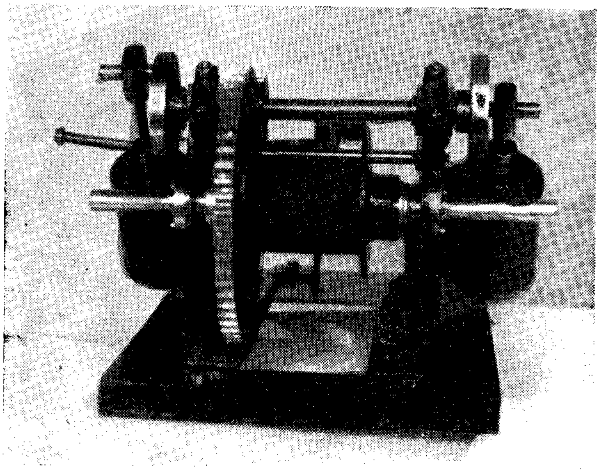
One of the packing washers can be seen in the photograph of the complete arrangement, on the stud to the left of the belt. With this arrangement the belt is slack when the worm is out of gear and tightens when the worm is in gear. The action of the control is quite sweet, and enables the leadscrew handwheel to be used if required to bring the tool up to the cut and the feed can be engaged without any delay.

The pulleys are kept in line as much as possible and a certain amount of belt adjustment can be obtained by swivelling the quadrant itself.

The writer hopes this will be of interest to readers possessing one of the new Myfords.

AN OSCILLATING CYLINDER WINCH ENGINE

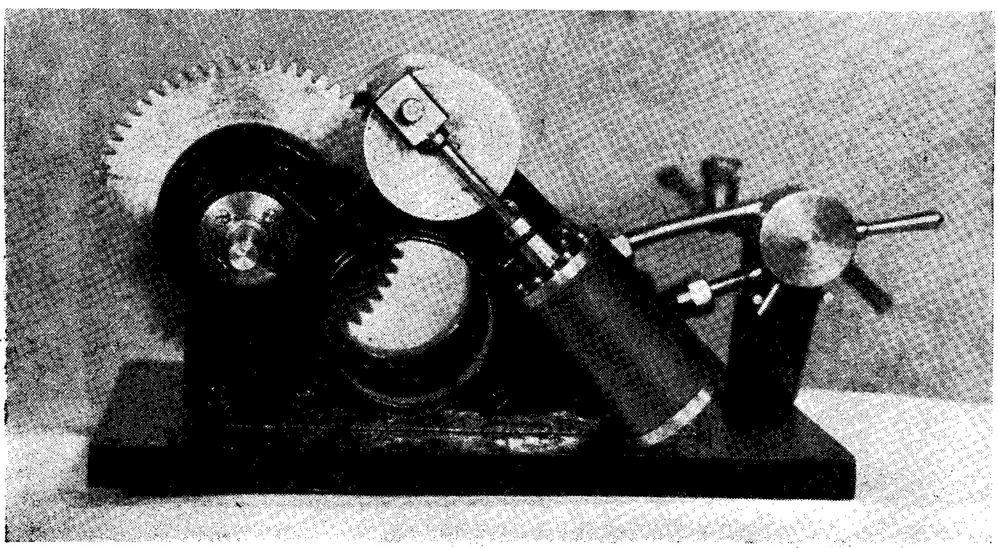
by H. E. Rendall



BEFORE giving a description of this little winch engine, I had better give the requirements that were made by a friend. In brief, a small engine was required to operate a model derrick, and the prospective owner, an old sailor, wanted something reminiscent of a ship's winch. These were usually made with two horizontal cylinders, geared down to a drum, but as he already had a Reeves horizontal oscillator, I did not wish to have horizontal cylinders again. Tangye's used to make a ship's winch with the cylinders arranged diagonally and this engine is fairly representative of a Tangye winch, except, of course, that they used slide-valve cylinders, whereas, to simplify labour, we used oscillating cylinders with a reversing valve. It has made up into a very pretty model with black base, green frame, which unfortunately has photographed as black, bright gunmetal cylinder covers, blue lagging and steel disc cranks. I cannot claim that this engine represents its prototype accurately, but all the same, oscillating engines were much used on board ship in the latter part of the nineteenth century for small power purposes such as ash hoists, steam steering gear and sometimes for reversing the valve gear of the main engines. They did not have flat valve faces as on this model, but the valve ports were cut in a hollow trunnion on which the cylinder oscillated. They, too, required no slide valve and were reversed by a simple valve.

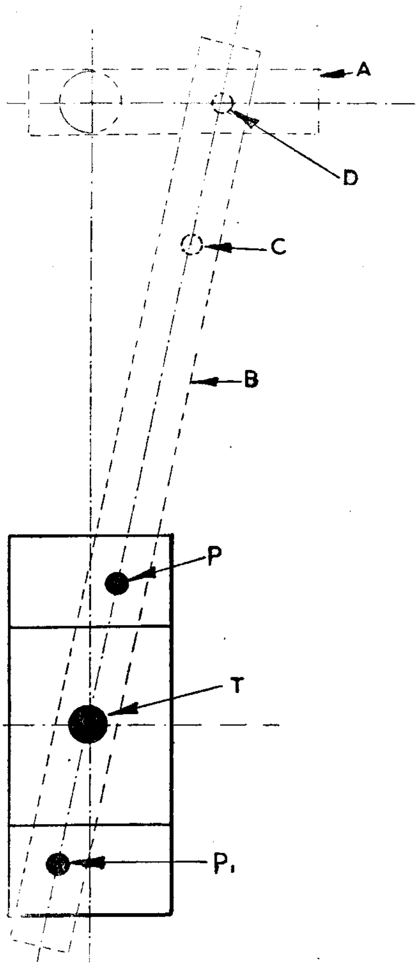
Builders of 2-cylinder oscillating engines, except for marine use, seem to have preferred the crank overhead arrangement, with cylinder axes at right-angles and driving on to one crankpin. Such was the arrangement of the small engines I have referred to, but it was found also in a big winding engine at Aberdare, 6 ft. stroke and 43 in. bore, and in a very much smaller engine at Churt. I wonder whether there are any drawings of these engines extant or has all their record been lost, together with oscillating cylinder petrol motors and other curiosities of engineering?

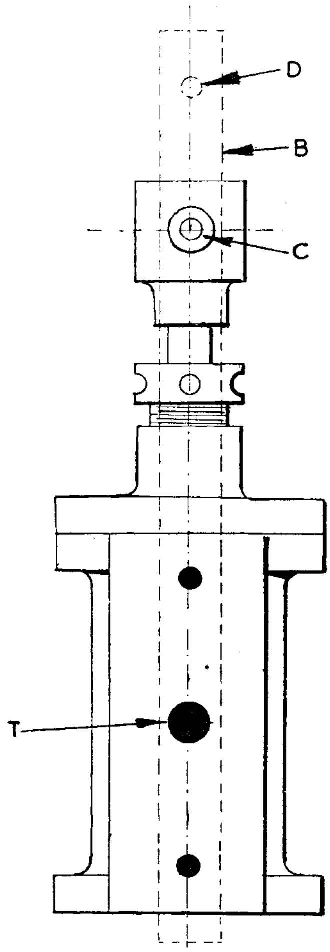
The oscillator has the reputation of being a poor, extravagant engine, suitable only as a beginner's first attempt. Perhaps it was often

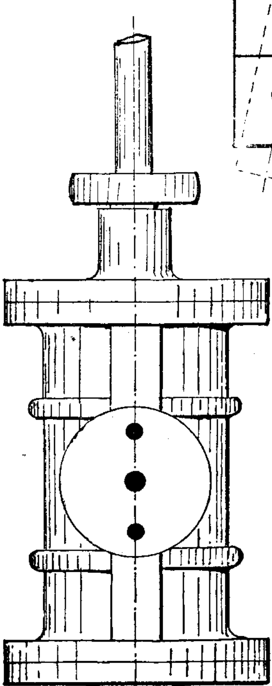


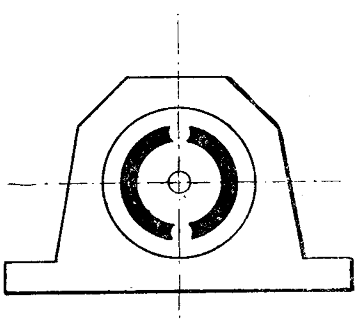
poorly designed and made. Fig. 1 is copied from an old book on model engineering, more than 70 years old. You will note that the ports are far too close to the trunnion pin and so give a very restricted opening for steam and exhaust. The trunnion pin was usually a piece of thin steel wire, that would certainly not hold the cylinder to its valve face, if any high pressure steam got into the cylinder. The winch engine has a 5/32-in. trunnion for cylinders $\frac{3}{8}$ in. bore × $\frac{7}{8}$ in. stroke, and the ports are as near the cylinder ends as possible, giving bigger ports and a very direct entry of steam to the cylinder.

In making oscillating engines I always like to make up a rough jig for drilling the ports in the cylinder and the valve face.









Above—Fig. 2

Below—Fig. 1

Fig. 3

This jig is shown in position in Figs. 2 and 3, drawn in dotted lines. First, there is a rough crank *A* of slightly greater throw than the engine's own crank and a piece of strip steel *B*. On the centre line of this strip mark off the trunnion hole *T*, the two ports *P* and *P*1, a hole *C*, through which a rod can be passed through the piston-head to ensure that the jig is in line with the cylinder axis, before using it to drill the ports, *vide* Fig. 3. The fifth hole, *D*, is drilled so that the crank is at right-angles, when the jig is assembled to drill the port holes in the valve-face, *vide* Fig. 2. Unless your drilling is accurate

(*Continued on page* 117)

A SMALL RADIO-CONTROLLED TUG

by Raymond F. Stock

THE tug illustrated was designed to be as small as practicable using standard components, and operates satisfactorily on a 6-ft. garden pond.

A tug was chosen as prototype since it provides a good ratio between volume available for mechanism and apparent size.

A preliminary mock-up of components indicated that the size could be reduced to 9 in. overall, and the hull was built to this length by aying up $\frac{1}{16}$ in. thick soft balsa planks over a temporary cardboard form.

The hull was completely finished and sanded while still on the form, and on removal consisted of a light but strong hollow shell. This was stiffened by two transverse bulkheads, and stringers at deck level, thus dividing it into three separate compartments.

Mechanism

An electrotor for propulsion was cemented in the bottom of the after compartment, spring-coupled to the propeller shaft. The propeller was soldered in a jig from brass sheet and with a diameter of $\frac{5}{8}$ in. gives a good scale speed while the batteries are fresh.

Above the motor the magnetic escapement was riveted to the after bulkhead. This component was simply made and is orthodox in design; it gives four positions—a sequence of neutral, port, neutral, starboard, and the movements are transferred to the rudder by a crude adaptation of the Scotch crank principle using wire linkage. Mechanical power is provided by the rubber band stretched across the midships compartment, and as the escapement wheel is converted from an old clock gear, the teeth assist in winding the " motor " (which is done by winding the wheel backwards with the finger).

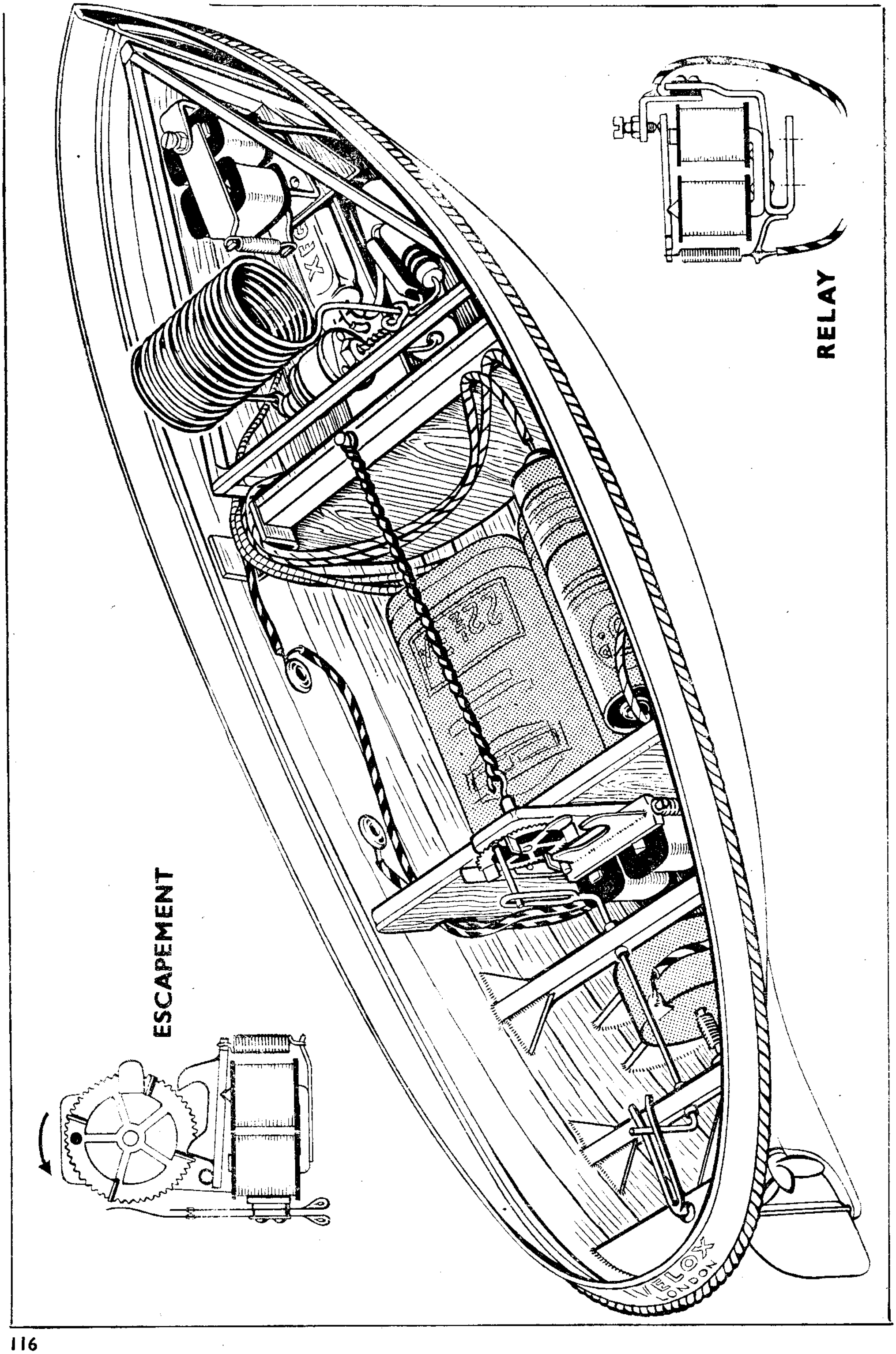
At one of the neutral positions a cam lobe on the periphery of the wheel was arranged to open a pair of contacts in the propulsion circuit, thus giving " stop."

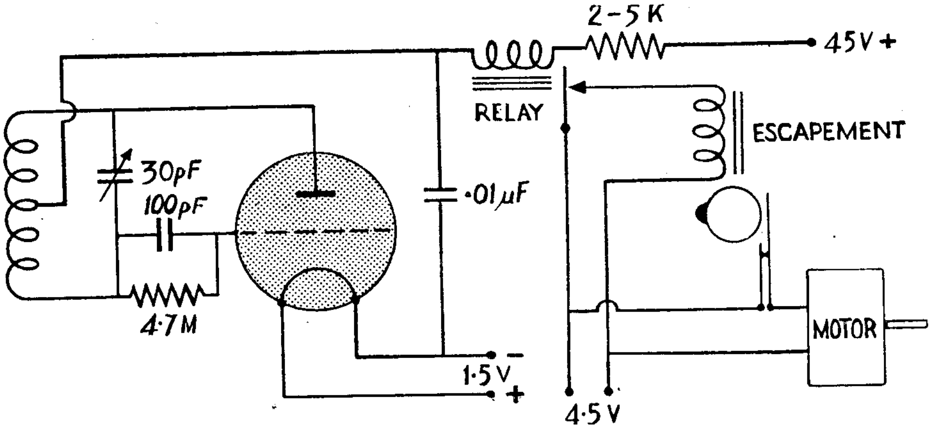
The amidships compartment contains the batteries; two $22\frac{1}{2}$-volt deaf aid batteries give 45 volts for H.T. and rest on the bottom. Above them to starboard is a single pen cell providing $1\frac{1}{2}$-volts L.T., and to port is a flat $4\frac{1}{2}$-volt torch battery operating motor and escapement circuits. The latter is omitted from the illustration in the interests of clarity. Connections to all the batteries are made with snap fasteners which simplify replacement and obviate switches.

The forward compartment contains the radio which is hung on a triangulated framework of balsa and paxolin struts, and is arranged to fill the awkward and otherwise wasted space in the extreme bows. Fig. 2 shows the circuit to be quite conventional and very simple—similar in fact to the radios used in small model aircraft. The gas-filled triode is a Hivac XFG1. No aerial or earth is provided and signal pick-up is entirely on the tuning coil, to facilitate which the coil is arranged to project through the deck into the deckhouse.

The superstructure is built on to the deck in one unit, and thus is simply removable for adjustments. The deck rests on the stringers and is suitably cut away under the deckhouse and engine room skylight to clear the tuning coil and the top of the escapement. The most important component in the model is the relay, since it must operate positively with a current change which may be only 0.05 mA and at the same time it had to be as small as possible.

The relay illustrated was made to a design which I have used successfully several times in more serious radio-controlled craft. Two 1,750-


RELAY
ESCAPEMENT
VELOX
LONDON



ohm bobbins from a Siemens relay provided the coils which were mounted on a core cut from the same component. One core arm was stoned to a knife edge and used as a pivot for the armature as shown. The fixed support for the contact-screw and the other framework were cut from brass, and in the interests of rigidity soldered or riveted together. Dimensions are not critical, but the movement of the armature must be restricted to about 2/1,000 in. and the spring tension carefully adjusted. One most important feature, too small to show in the drawing, is a 10-B.A. stub of brass screwed and sweated into the end of the right-hand core-arm. This is filed down until it stands just proud of the iron surface. Its function is to prevent the armature making magnetic contact with the pole-piece.

With the circuit shown, the standing current is in the region of 1 mA, and will dip on receipt of a signal to a value of 0.25 mA upwards, a low power transmitter being used.

Although very fascinating to operate, perhaps the most spectacular feature of the model is its running cost—a total of about 12s. 6d. an hour!

AN OSCILLATING CYLINDER WINCH ENGINE

(*Continued from page* 114)

beyond all question, it is better to use one side of the jig against the valve-face and the other against the cylinder; in this way, any small inaccuracies in drilling the jig are cancelled out. I have used this method for locating the ports in the little mechanical lubricators, that "L.B.S.C." is so fond of describing. I suppose that I must have made at least six and never had a failure, due to the accurate placing of the ports that this method gives.

For facing the side of the cylinder, I always mount it on an angle-plate, bolted to the faceplate, aligning the centre of the cylinder to the lathe axis, so that the trunnion pin-hole can be drilled and tapped from the lathe tailstock. If this is not done, there may be endless trouble in getting the valve-faces to run steam-tight, due to the trunnion-pin not being square on to the cylinder port face. Another fault of the early model makers was that the bearing surface of the piston-rod hole through the cylinder cover was inadequate. What is suitable for a fixed cylinder engine with a well fitted crosshead is useless for an oscillator. Even for a small engine like this I regard $\frac{5}{16}$-in. guide length for the piston-rod as the minimum, and I fitted a good hard bronze gland as well. Otherwise I should expect rapid wear at this point, followed by wear in the piston—I know, I have had some. The makers of small-power oscillating engines always fitted good long necks to their cylinder covers and occasionally there was a sort of flange above and below the piston-head to give extra bearing surface.

The framing and base are built up out of $\frac{1}{16}$-in. steel plate, the base being strengthened by an edging of $\frac{5}{16}$-in. square steel. This part of the construction was curiously like building a locomotive. The two side frames were riveted together and filed up to shape. Steam and exhaust pipe-holes were carefully laid off so that the pipes would align into tee-pieces. One side was rigidly silver-soldered to the tee-piece, and the steam pipe from the other side fitted into it and was made tight by a piston-rod type gland. The pipes from the reversing valve are also fitted to the tee-pieces with glands. This joint allows the pipes to expand freely without causing any strains, and in service has proved very satisfactory. The drum is geared down, about 1 : 4 with 20 d.p. steel wheels, obtained from an advertiser. On test the little engine ran very well and played with the faceplate of a 4-in. lathe weigh 4 lb.

Model Crankshaft Production

by A. Ronald Allen (Canada)

BUILDERS of small engines have a choice of several methods of crankshaft making, and some seem to derive a great deal of satisfaction from being able to say, " I turned it from a solid chunk, and it took 60 hours ! " or, " the blank for that crankshaft weighed $3\frac{1}{2}$ lb. when I started on it and the finished job just weighs 12 oz. ! " This article is not for such people, but for those who want a two-crank, 90 deg. shaft as quickly as it can be made, and with the minimum of lathe work.

To make the shaft a piece of flat steel is required, with the same width and thickness as would be called for when making a single-throw crank, but long enough for a two- (or maybe three-) throw crank. If the material used is cold rolled-steel, it should be heated to redness and allowed to cool slowly before any work is done upon it, in order to relieve any internal stresses. The first operation is to mark out the two pairs of centres on the ends of the piece of steel; also, the position of the crank webs, and drill the centres. Then the piece is mounted between centres, using the proper centres for the crankpins, and the crankpins are finished up, being in line with one another. Fig. 1 shows the crankshaft after this has been done, and the next operation is to cut out the three sections shown by the shading and dotted lines, including the centres used for machining the crankpins, as these will not be required again. Next we return the crankshaft to the lathe and rough-turn the main journals 1/32 in. or $\frac{1}{16}$ in. oversize. It may be advisable to make block *B* in Fig. 2 before doing the rough-turning, and drill a hole in it 1/32 in. or $\frac{1}{16}$ in. over the finished size of the crankshaft journals. This block can then be used as a gauge for the rough-turning of the journal which enters it for the twisting operation. When the rough-turning is done the crankshaft should be mounted as indicated in Fig. 2, with one pair of webs bolted down to block *A* and one main journal entered into block *B*, both blocks being secured to a suitable baseplate. It is essential that the crankshaft is not sprung out of line by securing it to the block *A* or the crankpins will be out of parallel after the shaft is heated and twisted. A small piece of flat steel, which should be straight, is secured to the pair of webs next to block *B*.

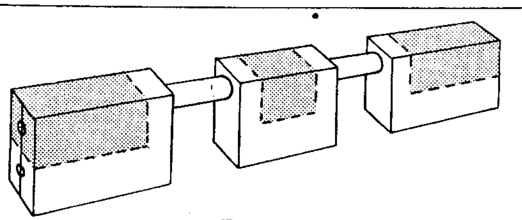


Fig. 1

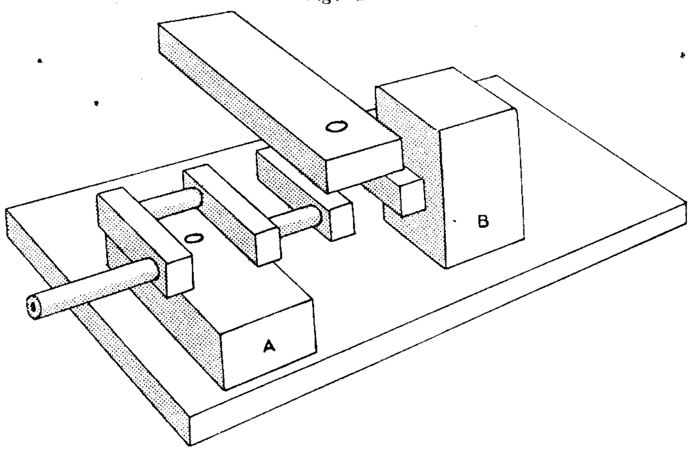


Fig. 2

When the set-up is completed, the main journal between the cranks is heated to redness and the shaft twisted so that the two cranks are at 90 deg. to each other, or, if the shaft is for a three-crank engine, 120 deg. The small piece of flat steel which is secured to the " movable " webs can be used for a lever during the twisting operation, and also to use a square or bevel protractor against for testing the angle. After cooling, the crankshaft is returned to the lathe and the main journals turned to finished size. If counterweights are required, they may be attached to the webs, which could be left a little long for this purpose.

Fig. 2 has been drawn as a perspective sketch, and I thought that any attempt to include bolts as fastenings for the various parts might complicate the drawing unnecessarily.

A 10 c.c. "Vulcan"

by J. A. K. Laidlaw

ON seeing the "Vulcan," a home-made four-wheeler throwback to the early days of motoring, I feel sure that readers of THE MODEL ENGINEER would be interested to learn something of her construction and then to compare her with the motor-cars of today.

Take a look at the drawing of her. Now suppose we start working from left to right of it.

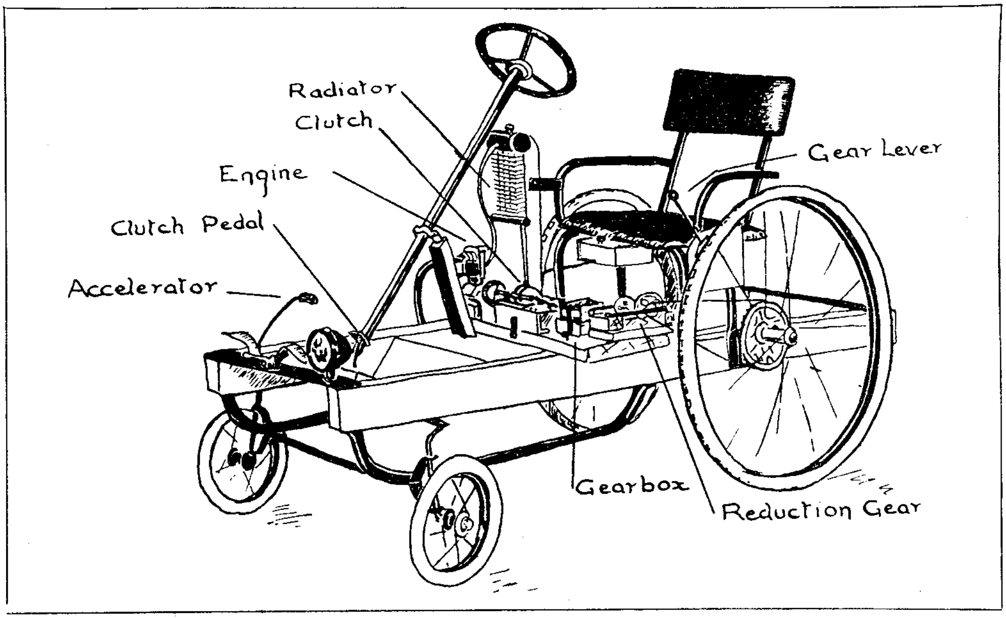
The first thing we notice is that the transmission system runs across the vehicle just slightly in front of the seat. The engine is a 10 c.c. C.I. Special four-stroke, with a silencer which can be clearly seen in the picture, also a radiator, the motor having been converted from air to water cooling. Further along we can see the clutch plates, two aluminium pulleys which came from a bombsight computor, fitted with cork inserts.

The gearbox provides three speeds, two forward and one reverse. The gears had originally been taken from an R.A.F. camera gearbox. At the foot of the drawing we see the final reduction gear (about 60 : 1) with the chain drive leading up to one rear wheel.

On the left is the clutch pedal. The gear lever projects out of a gate cut in the box.

A rope round a broom handle, with its ends fixed to the track rod, forms the rather crude steering gear, which, unfortunately, often comes unhooked, consequently resulting in disastrous happenings! The rear axle runs in ball-bearings.

(*Continued on page* 123)



IN THE WORKSHOP

by "Duplex"

94.—Making a Sand-blasting Appliance

AT first sight, it might be thought that an appliance of this kind would be seldom required in the small workshop, but once experience has been gained with a sand-blasting machine its general usefulness will be fully appreciated. Although a small sand-blast is commonly used for removing the carbon from dirty sparking-plugs, this machine will also give an excellent finish to metal parts and, in this way, will save much filing and handwork with abrasives. Many garages are equipped with small sand-blasting machines designed for rapidly cleaning sparking-plugs, and a typical example is illustrated in Fig. 1.

As will be seen, the plug is carried in a rubber hood that can be rotated so as to bring all parts of the plug into contact with the stream of sand issuing from an internal vertical nozzle.

The arrangement of the parts of the machine is illustrated diagrammatically in Fig. 2. When a sand-blast is used for this purpose, the velocity of the sand stream is purposely restricted, for the object is to remove only the carbon from the central electrode, and from the surfaces forming the gas space of the plug without doing damage to the plug parts. This reduction of velocity is obtained by fitting a perforated washer in the air passage so as to reduce the volume of air entering the delivery nozzle.

A sparking-plug cleaned by this process has an attractive, fine-grained finish rather like dull plating; the effect produced by sand-blasting a dirty plug is shown in the photograph Fig. 3.

Clearly, the action of the blast will tend to force sand grains into the top of the gas space in the plug; this sand must, therefore, be removed before the plug is again put into service. To do this, an external jet is fitted to the top of the cleaner, as shown in Fig. 1, and a blast of clean air is obtained by pressing down the jet itself. The principle on which the sand-blast works is similar to that employed in the paint gun recently described, but, here, the medium used is solid sand grains instead of liquid paint. Although some paint guns have a valve for controlling the delivery of the paint, this is unnecessary in a sand-blast, as, for all ordinary purposes, the maximum output is always required. The apparatus is, therefore, designed so as to offer as little resistance as possible to the flow of sand, and the control or operating valve on the air line has merely an open and a shut position. Fig. 4 illustrates diagrammatically the construction of a sand gun with its control valve. When the valve opens, and air at high pressure is admitted to the jet, the air stream in passing through the combining cone gives rise to a partial vacuum in the space immediately below.

The negative pressure set up in this way causes the sand to be drawn up the pipe and into the base of the nozzle; there, the sand grains mix with the outgoing air in the combining cone and are then expelled at high velocity.

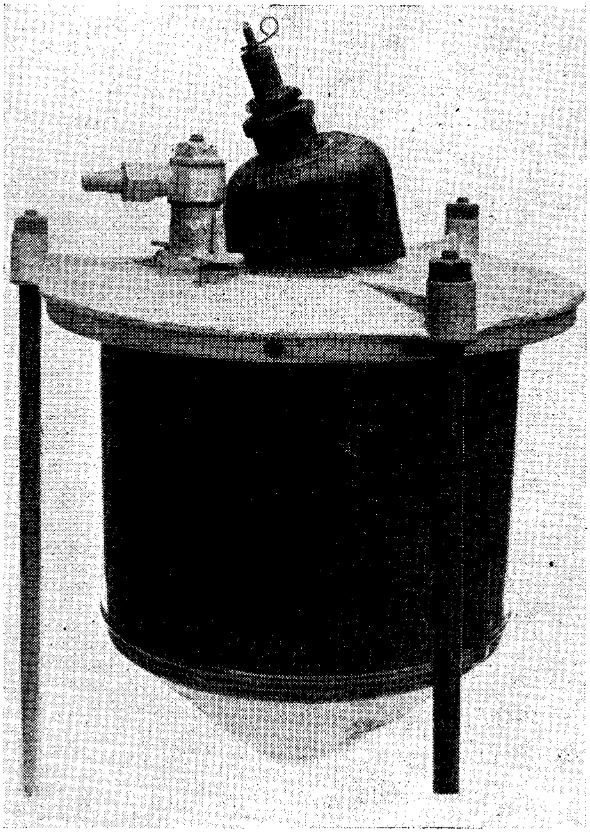
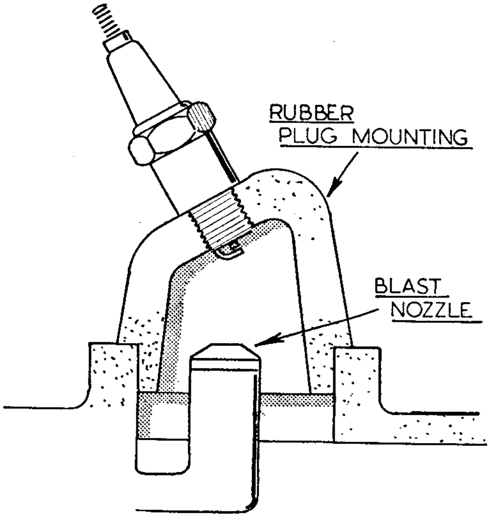


Fig. 1. A commercial sand-blast for cleaning sparking plugs



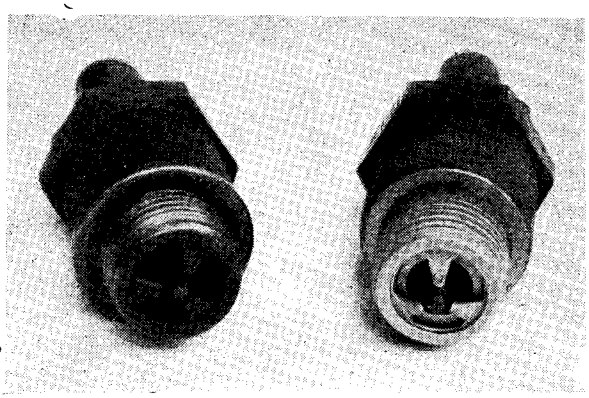
of motor cars. The two end walls of the cabinet are composed of rubber sheeting in which holes are cut for the passage of the hands, but the rubber should fit closely round the wrists to keep the sand from escaping. The rubber sheeting, of course, tends to restrict to some extent the free movement of the hands, but if a discarded inner tube from a car tyre is cut up, it will be found that the sheets so formed have the shape of a shallow funnel and so will allow the hands to work more freely within the cabinet. However, those who are adept at sewing may prefer to make a pair of fabric sleeves of the kind fitted to photographic changing-bags. It will be seen that the rubber sheeting is held in place by the angle strips that also serve to clamp the celluloid sheet to the edges of the cabinet.

The sand gun illustrated in Fig. 6 is mounted on two angle cross-members, where it is secured in place by means of the studs and distance-pieces shown in the sectional drawing, Fig. 7. The body (A) of the device is made of brass, duralumin, or steel and houses the control valve as well as the complete nozzle assembly. The

Above—Fig. 2. Section of a sand gun used for plug cleaning

Right—Fig. 3. A sparking plug before and after sand-blasting

Bottom right—Fig. 4. Showing the constructional details of a sand gun

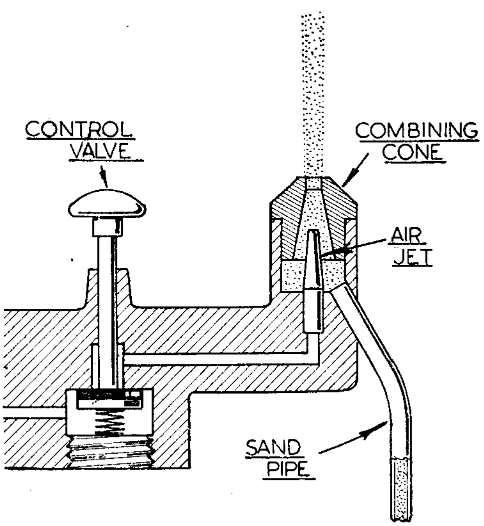


The Workshop Sand-blast

Experience with the plug-cleaning machine naturally led to making experiments to find out whether, with some modifications, this appliance could be used in the workshop for finishing metal parts such as filed work and unmachined castings.

There is no need to describe the experiments that led to the designing of the apparatus illustrated in Fig. 5, but at the outset it was clear that the gun would have to be totally enclosed in a cabinet in order to keep the sand from being widely scattered.

The most convenient working position was obtained with the delivery nozzle set at an angle of 45 deg., and, even with the small sparking-plug gun, machined surfaces were given a very pleasing finish. The main framework of the cabinet is built up from angular material formed from strips of 20-gauge sheet tin ; this form of construction proved useful when attaching the hopper and other fittings to the cabinet. To obtain good visibility when working, the walls of the cabinet, where possible, were made of transparent celluloid material, such as is used for the side screens



control valve (*B*) is a spring-loaded piston valve that need not be fully air-tight, for, unlike the paint gun, a small air leak will not cause ejection of the sand. This valve works in a cylinder machined in the body itself.

The nozzle assembly consists of a nozzle base (*C*), screwed into the body, and an air jet (*D*) made a press fit in the base-piece.

In addition, the combining cone or delivery nozzle (*E*), is also made a push fit in the base-piece to allow for easy replacement when the part becomes worn by the passage of the sand stream, but the cone will last longer if made of steel and then hardened.

As already mentioned, a special kind of sand is used in the plug-cleaning outfits, and when a fresh supply of sand is bought at a garage, or from the makers of the sand-blast, a new combining cone will be found included in the container. It is not, therefore, necessary to make the cone specially, but this part will be required to obtain the correct dimensions when making the nozzle base. The nozzle base, carrying the air jet and the delivery cone, is made of mild-steel and is threaded to take the sand pipe (*F*) leading to the sand hopper. The air jet is turned from

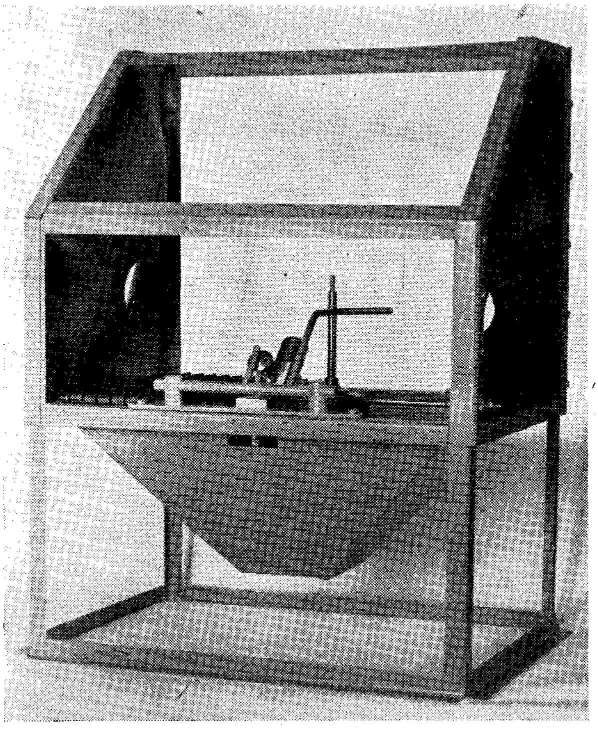


Fig. 5. The workshop sand-blasting machine

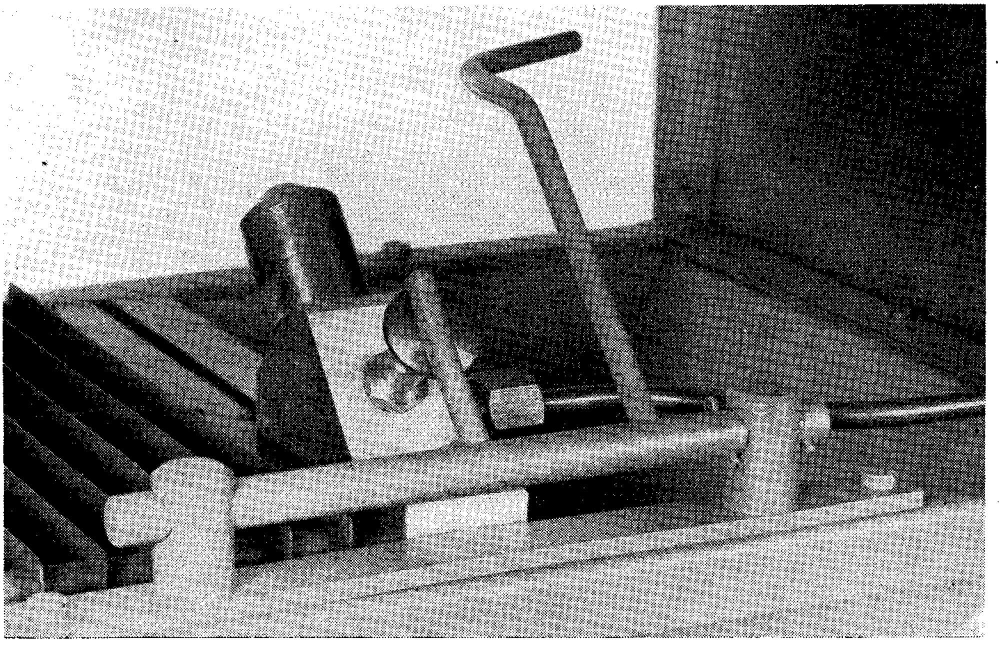


Fig. 6. The sand gun fitted with its control mechanism

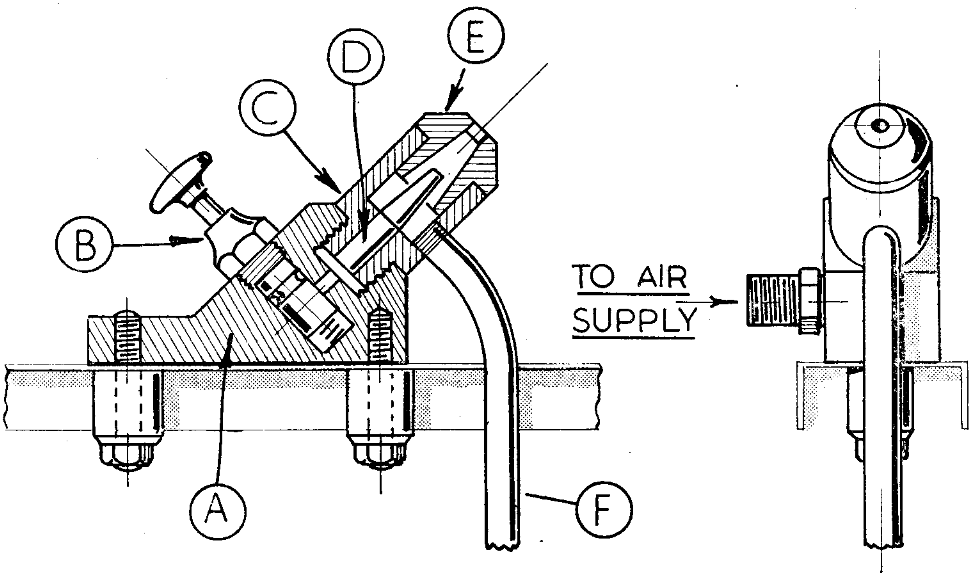


Fig. 7. Details of the workshop gun. " A "—the body ; " B "—the control valve ; " C "—the nozzle base ; " D "—the air jet ; " E "—the combining cone ; " F "—the sand pipe

mild-steel rod, and its upper end should lie ⅛ in. below the abutment face formed on the nozzle base for the combining cone.

The sand pipe (*F*) is a short length of copper tubing of ¼ in. outside diameter. The pipe is bent so as to dip vertically into the hopper, and the lower end is cut off at an angle of 45 deg. to allow the sand to enter freely.

The description of the construction of the sand-blast will be continued in the next article, together with working drawings of the parts.

(To be continued)

A 10 c.c. "Vulcan"

(Continued from page 119)

The simplest possible type of gearbox is used with one sliding gear keyed on the mainshaft. This is moved to engage reverse and 1st, and between this is the neutral position. To attain top gear, the sliding gear is moved completely through 1st, when a dog clutch on the gear, brought into engagement with a dog clutch on the jackshaft, gives a straight through drive.

The noise made by the car when running, is caused by the couplings between the various parts of the transmission and the over-run noise made by braking on the engine. A Mark I version was powered by an E.D. 3.45 c.c. " diesel." The same gearbox was used and the rest of the transmission was the same, but wear and tear on the gearbox was appalling, as the gears had to be changed without throttling down the engine ! The maximum speed of this vehicle was about 4 m.p.h., compared with the 6 m.p.h. of the Mark II version.

The Mark III version is, at the present moment, still in the making. It will have exactly the same engine, but will be furnished with an entirely new transmission. It will also have a three-speed, completely enclosed gearbox, all gears engaged by means of dog clutches, and it will be run in oil. The chassis has already been completed and the gearbox is now in the making. In addition it will have I.F.S., sprung rear axle with differential action and brakes (bicycle type, with foot and hand control), which will be on the rear wheels. The differential is made out of two sets of hand drill gears cased in with part of an old Bosch horn casing.

This car will be driven in a garden and not on the road ; 6 m.p.h. is fast enough on most corners and requires quite an amount of skill on the part of the driver.

A ½-in. hand bench drill is the only machine tool used for making this vehicle, and the constructional methods are, therefore, somewhat crude. Things seemed to have improved after the recent addition of some taps and dies, not to mention the whole of the " Wolf Cub " home constructor outfit.

Most of the vehicle is made of wood, including the chassis side members.

Looking at the picture showing a driver with the vehicle gives us the comparative size of the motor !

This is probably the only car in which a miniature engine (10 c.c.) has been used to propel a full-sized passenger.

Queries and Replies

Enquiries from readers, either on technical matters connected with model engineering, or referring to supplies or trade services, are dealt with in this department. Each letter must be accompanied by a stamped, addressed envelope, and addressed : "Queries Dept.," THE MODEL ENGINEER, 23, Great Queen Street, London, W.C.2.

Queries of a practical character, within the scope of this journal, and capable of being dealt with in a brief reply, will be answered free of charge.

More involved technical queries, requiring special investigation or research, will be dealt with according to their general interest to readers, possibly by a short explanatory article in an early issue. In some cases, the letters may be published, inviting the assistance of other readers.

Where the technical information required involves the service of an outside specialist or consultant, a fee may be charged depending upon the time and trouble involved. The amount estimated will be quoted before dealing with the query.

Only one general subject can be dealt with in a single query ; but subdivision of its details into not more than five separate questions is permissible. In no case can purely hypothetical queries, such as examination questions, be considered as within the scope of this service.

No. 9924.—Calculating Cubic Capacity
S. O'S. (Kilburn)

Q.—Will you please give me the formula for finding the cubic capacity of an i.c. engine, such as a twin 1 in. bore × $\frac{7}{8}$ in. stroke, 4-stroke for example.

R.—The cubic capacity of an i.c. engine is found by measuring up the volume displaced by the piston at each complete stroke. In the case of the engine you mention, it is first necessary to find the area of the piston, which is done by using the familiar formula, πr^2, or in other words, half the diameter multiplied by itself and then multiplied by 3 1/7, and when this figure is multiplied by the length of stroke, this will give the complete displacement for one cylinder. If the calculation is originally made in inches or fractions of an inch, the result, of course, will be in cubic inches, but this can be converted into cubic centimetres by multiplying by 16.39. This calculation applies whether the engine is 2-stroke or 4-stroke ; or even a steam engine, or air compressor.

No. 9925.—Universal 35 mm. Double-Frame Projector
S.W.W. (Bristol)

Q.—I am shortly commencing construction of the above projector, but as I have no facilities for machining the objective and condenser housing, I shall be pleased if you will give me your advice on the following point. I have in my possession a first-grade 3 in. diameter condenser which I wish to use in the above. Could you indicate to me the adjustment which may be necessary in the measurement and construction of the housing so that I can prepare a drawing for the firm which will do the job for me.

R.—It is impossible to give you definite information on the design of the optical system of your projector, as condensers of a given size are not necessarily all of the same focal length. We note you are using a 3 in. diameter condenser, which is really larger than is necessary for covering the size of a double-frame 35 mm. film, and in that case, it would probably be found desirable, in the interest of maximum efficiency, to locate the condenser rather farther from the focal plane of the film than is usual. The best way to check up on the distances and amount of adjustment required in optical systems is to improvise a simple form of optical bench by setting up the components in their approximate positions, arranging a suitable illuminant also in the normal position, and testing out the covering power, and focussing by shifting the various components. When suitable conditions have been arrived at, the relative positions of the various components are measured. The test should, of course, always include the objective it is proposed to use with the optical system.

No. 9926.—Brake Testing
W.H.L. (Kensington)

Q.—I am making a brake test on a small electric motor using a simple cord brake. Can you tell me, in simple language, how to make the calculation ?

R.—In using a simple cord brake working over a pulley attached to the motor shaft, the weight should be arranged so that it tends to lift with the frictional pull on the cord, and it is desirable to use a light spring-balance on the other side of the cord to provide the necessary friction, but the reading on the balance is deducted from whatever weight is hung on the cord. For simplicity of calculation, the circumference of the pulley should be some definite fraction of a foot, and the calculation is thus as follows :—

$$\frac{W \times N \times D}{33{,}000} = B.H.P.$$

where W is the weight (in lb.) lifted, N the number of revolutions per minute and D the circumference of the pulley in fractions of a foot.

PRACTICAL LETTERS

A Lathe Tip

DEAR SIR,—Finding out that my 3-in. lathe centres were out of alignment due to the front spindle bearing wearing down more than the back, through using a heavy 4-in. chuck, I have made a practice of putting this chuck on the rear end, held on with its drill jaws, when not in use, first taking off the pinion gear and pushing the banjo out of the way. When this chuck is required for use, another chuck is put in its place, to balance out the wear.

Yours faithfully,

Tottenham. C. CLAXTON.

Model Engineers and Others

DEAR SIR,—I am a little surprised at the tone of the latter part of Mr. A. L. Hutton's letter in the issue of June 14th.

May I point out to this gentleman, that it is the easiest thing in the world to criticise someone else, but quite another thing to do anything yourself.

Messrs. "Duplex" have done great service to model engineers by giving them their various ideas and designs. May I enquire what Mr. Hutton has done in this sphere?

With regard to the end of Mr. Hutton's letter, and in particular to the remarks about "Duplex" that he quotes; I note he is careful to omit the name of the speaker.

The remark made seems to me to be one of those "wisecracks" that at first hearing sound funny, but upon consideration become more and more stupid.

Naturally, I do not know to which of the gentlemen the inference referred, but may I tell Mr. Hutton, that some years ago one of the "Duplex" team amputated the end of one of my fingers, and that the craftsmanship was superb. I think, therefore, that the skill of any associate of this particular gentleman will be upon a like plane to his own.

Yours truly,

Ottery, St. Mary. E. M. THOMAS.

[Without taking sides in this matter, or implying that the views of our correspondent agree with our own, we think that it is only fair to Mr. A. L. Hutton to point out that he is, by no means, a mere armchair critic, but has, to our knowledge, produced several outstanding examples of model engineering craftsmanship.—ED. "M.E."]

Camera Construction

DEAR SIR,—With reference to Mr. J. Gordon Hall's letter entitled "Camera Construction" which appeared in the issue of June 21st, I would like to make the following comments. The ½-plate camera, while being admirable as regards size is rather expensive to maintain, and the ¼-plate size is, in my opinion, rather too small. Therefore, I would suggest a 5 in. × 4 in. size camera as a happy medium. I agree with J.G.H. that the camera should have a triple extension, but in addition, should have rising, falling and cross movements of the lens panel, a tilting base and front. These features are necessary to overcome the difficulties of converging verticals, horizontals, and other distortions that arise in model engineering and architectural photography. Such a camera should not present any difficulties in manufacture. The only extras that need to be purchased are a lens (of not less than 6 in. focal length) complete in a shutter and possibly bellows for the camera extension, and a piece of ground glass for a focussing screen. The complete outfit should cost much less than half the price of a new or second-hand camera of similar construction.

Yours faithfully,

Peterborough. LESLIE A. BEELS.

"Britannia"

DEAR SIR,—May I, as a footplate man, express my opinion on "Britannia."

Being a two-cylinder job, she does not have to be run over inspection pits to oil up inside masses of motion; thus the driver is in no danger of being mangled up if some other engine gives him a bump, as has happened many times.

The full floor to the tender ensures that the fireman will not be losing any boot soles through being trapped by tender fall plates; also, a continuous roof between engine and tender will save many uncomfortable trips. The angle cab windows will keep us from sticking our necks out in blinding rain, looking for "distants" being on.

The rocker bars enable fires with a foot of clinker to be dropped in less than two minutes, which ends crawling under to rake out ashpans and being choked with sulphur fumes.

Any fireman who is used to being thrown across the cab on 4-6-0's doing their 80's and 90's will appreciate a trailing truck under his feet.

Well, that's what the enginemen think of her. Myself, I'm longing to get the regulator straight back on her and see what she makes of Bleamoor and Aisgill; I bet "L.B.S.C." wouldn't mind learning that road.

My only grudge is the padded seat for the driver and the wooden bench for the fireman!

Yours faithfully,

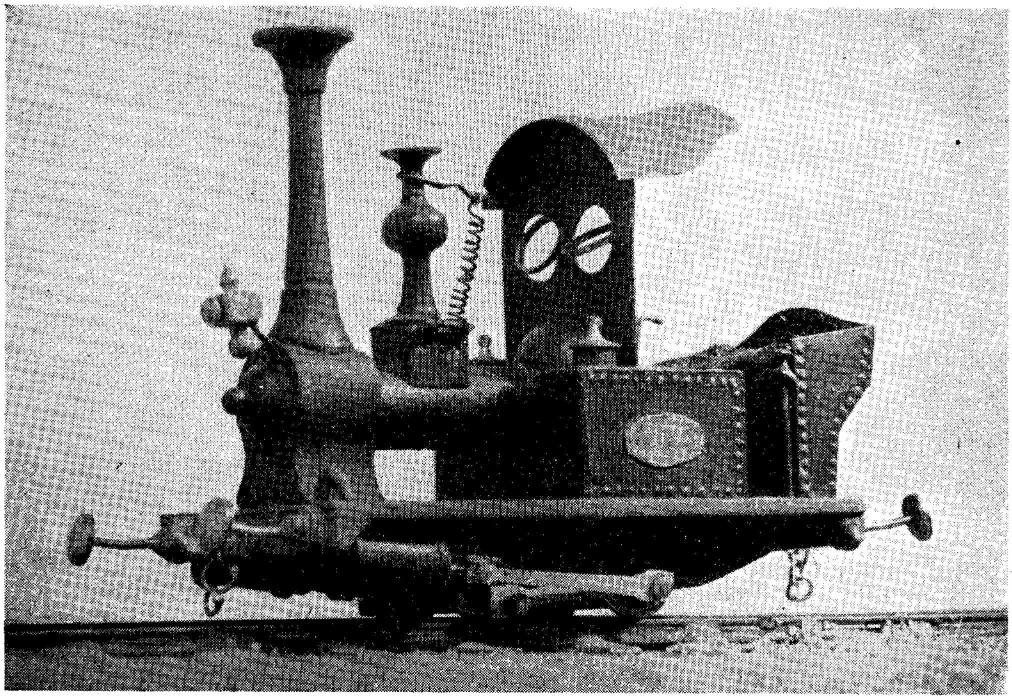
Leeds. BOB FOSTER.

(Driver.)

Emett Locomotives

DEAR SIR,—Mr. Barnett's letter (page 845, June 28th) prompts me to send you a photograph of a model "Nellie" which I fabricated some months ago. Perhaps Mr. Barnett may feel that this one is a little better adapted to the task of conveying a lady and gentleman from a gleam of sunshine to the next cup of tea. It is supposed to be built to 4 mm. scale and disports itself charmingly on 16.5 mm. gauge track. It is 3¼ in. long over buffers and stands 2¼ in. high to the top of the chimney.

The running plate is 1 mm. plywood and the frame, boiler, smokebox, side-tanks, and coal bunker, are all odd pieces of wood. The boiler, needless to say, is a piece of dowel rod. Bristol board overlays were applied to the tanks and bunker to provide rivet detail and conceal end grain. The spectacle plate and cab roof are thin nickel-silver. The chimney, the "dome," and the tank filler caps, were turned from a piece of dural rod. The buffers are small brass washers soldered to wire nails. The headlamp was produced in a four-jaw chuck (believe it or not). The wheels were turned from brass rod and mounted on "Insulaxles" so that the creature can stand around on the track without causing sparks to fly.



The spectacle plate lookout frames are most important to the complete effect, and it was essential that they should be tipped at just the right angles. They were turned off the end of a piece of thin-walled brass tube and lightly soldered in place.

Yours faithfully,
London, W. JOHN H. AHERN.

Those Model Fodens

DEAR SIR,—On behalf of Mr. K. P. Wise I should like to reply to the question raised by Mr. E. N. Sinder in his letter headed "The Model Fair" in your June 21st issue.

Mr. Wise's model Foden tractor is based on an engine owned by Mr. P. Cole, a Bristol showman. The model is quite accurate, except that the rear wheels are slightly undersize, and it has captured the "character" of the original very well indeed.

I know of four engines of the type owned by Mr. Cole, three of them belonged to showmen and one to a haulage contractor. I measured this latter engine before it was broken up. I did not make a note of the tyre sizes, but the diameters, over rubber, were:—front 2 ft. 9 in., rear 3 ft. 3 in. There was no winch on any of these engines and the water tank was placed under the chassis between the firebox and the rear axle.

The object behind the cab on the model which Mr. Sinder mistook for a winch is, in fact, the dynamo. It was not possible with these engines to mount the dynamo in its usual place in front of the chimney, so it was placed on the rear platform and two holes were cut in the back of the cab for the belt to pass through.

I think Mr. Sinder is right in saying that these engines did not leave the works as tractors. My theory is that they were built as the tractor part of articulated wagons. I never saw one of these wagons but the photographs in Foden's catalogue led me to this belief. Also, the rear platforms on all the engines differed, suggesting that they were built by the individual owners. Their small wheels seemed more suited to road work than the large ones fitted to the tractors and intended for timber hauling, etc.

I should like to wish Mr. Sinder success with his models, and I hope that photographs and descriptions of them will appear in THE MODEL ENGINEER in due course.

Yours faithfully,
Bradford. N. S. BRYANT.